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UNITED STATES OF AMERICA.

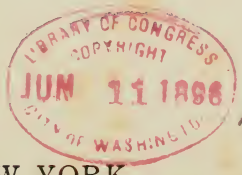
A MANUAL OF

MENDING AND REPAIRING

WITH DIAGRAMS

BY

CHARLES GODFREY LELAND



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INTRODUCTION

The author of this work modestly trusts that all who read it with care will admit that in it he has distinctly shown that mending or repairing, which has hitherto been regarded as a mere adjunct to other arts, is really an art by itself, if not a science, since it is based on chemical and other principles, which admit of extensive application and general combination. It has its *laws*—a fact which has never been hinted at by any writer, since all recipes for restoration in existence are each singly inventions made to suit certain cases. This work has been conceived on a different principle.

A thorough knowledge of this art of repairing, mending, or restoring various objects is of very great value, since there is no household in which it is not often called into requisition. In the kitchen or drawing-room, in the library and nursery, there are daily breakages, of which a large and needless proportion are losses, simply because such a man as a general mender, who is accomplished in *all* branches of the art, does not exist. And, what is more, it is equally true that no one has ever realised to what a vast extent mending and saving may be carried, with a little expenditure of time, practice, and money, by any in-

telligent person who will devote serious attention to it. Within a comparatively few years discoveries in science or in nature have enlarged the ability of the mender to an extraordinary extent—I need only mention the applications now made with silicate of soda, celluloid, gutta percha, and glycerine to confirm what I say—so largely, indeed, that only the accomplished technologist and chemist is really aware of what can be done in general repairing compared to what was possible only a few years ago. I believe that there are few thoroughly practical persons (and, I may add, few who take an interest in art in any form, or even in books) who will read this work without deep interest, and without acquiring information of such value that in comparison to it the cost of the book will seem a trifle.

Though mending or restoring is a subject which in some form comes home to and concerns everybody, and which it is assuredly everybody's interest to understand, this is, I believe, the first book in which its application to a *great* variety of wants has been made, and that in such a clearly co-ordinated manner, and according to such a simple principle, that whoever reads it can have no difficulty in mending any object, even though it be not described here. In all works of the kind which I have seen the recipes for repairing have been given simply according to their *subjects*, without any view to general principles of application, and a great proportion of these were in turn simply copied from old books of miscellaneous "receipts," or newspapers in which every so-called new discovery is announced as infallible, or as if it had been tried and tested to perfection. That I

have not recklessly accumulated in this fashion all kinds of *recipes* to fill my pages will appear very plainly to every chemist or technologist, who will perceive that, proceeding from a comprehensive table of generally recognised and long-tested bases of cements, I have given deductions and combinations scientifically agreeing with their laws and with experiment. The true object of giving a great number of recipes has not been solely or simply to supply the housekeeper or mechanic with instructions for certain repairs, but also to suggest to the technologist and inventor new ideas and applications. Thus, when we know that given proportions of zinc in powder, silicate of soda, and chalk form a strong cement, resembling zinc, it is as well to suggest that this may be varied by employing other metals and substances, such as bronze-powders and mineral oxides, to be always preceded by a little experiment. I venture to say that any intelligent person who masters this work can, on this hint, make for himself innumerable inventions ; and I am sure that there is not the editor of a single technological journal who will not testify to the fact that every year a great many patents are taken out and fortunes made from recipes which are neither so scientifically combined nor practically useful as those which I here give. That there are fortunes still to be made is abundantly proved by the fact that there are very few people, comparatively speaking, who know where to get or how to make waterproof glue, or how to mend with it, neatly and durably, shoes, umbrellas, and many rents in garments ; how to unite a broken strap ; mend, by felting, torn hats ; rehabilitate perfectly worm-eaten and torn-away paper ; re-

store decayed broken wood ; or mend, in fact, anything except with common glue or mucilage—both of which soon give way and crack or melt. So long as such general ignorance prevails, just so long there will be an opportunity for the inventor to make and sell cements, and for the repairer to find employment.

I call special attention to the fact that this book contains no merely traditional, untested recipes which have been simply transferred from one Housekeeper's Manual to another for generations. Where I have not been guided by my own personal experience—which is, I venture to say, not very limited—I have either followed truly scientific works, such as the three hundred volumes of the Chemical-Technical Library of A. Hartleben ; or, when citing from older authors, have invariably given recipes which agree with the principles advanced by modern analysts and inventors. And though not a professor of chemistry, yet, as I studied it and natural philosophy in my youth under Leopold Gmelin, L. Passelt, and Professor Joseph Henry, I trust that I have been sufficiently qualified to avoid errors in what I have written. In short, that I have *not* recklessly accumulated every recipe which I could find, and that what I give are really trustworthy, will appear plainly to the chemist or technologist, who will perceive that, proceeding from a given table of generally recognised and long-tested bases of cements, &c., I have then given deductions and combinations scientifically agreeing with their laws and with experiment. My book is not a *pièce de manufacture*, or of hack-work, but one which is the result of many years of practical experience in the minor arts and industries, on which

subject alone I have published twenty-two works, without including pamphlets, lectures, and at least one hundred letters or articles in leading magazines and newspapers. There is, in short, very little mending or making described in this book which I have not at one time or other personally effected, having had all my life a passion for mending and restoring all kinds of objects, and that scientifically and thoroughly.

As I have observed, there is in every household continual breakage of many kinds—"or of the rending which cries for mending"—it is a matter of some importance that some one in the family should pay special attention to such matters. How often have I seen very valuable objects stuck together—anyhow and clumsily—with putty, wafers, sealing-wax, glue, flour-paste, or anything which will "hold" for a time, when a perfect cure might have just as well been effected had the proper recipe been taken to the first chemist. This is equally true as regards taking ink or stains out of garments, or repairing the latter perfectly, or mending shoes or indiarubber cloth, or felting worn hats and many other articles, all of which are treated of in this work.

It is true that everybody is not naturally ingenious, or clever, or gifted, but all may become *skilful menders* if they will duly consider the subject (which requires no hard study) and experiment on it a little. And here I would seriously address a few words to all who are interested in education. There is a certain faculty which may be called constructiveness, which is nearly allied to invention, and which is a marvellous developer in all children of quickness of

perception, thought, or intellect. It is the art of using the fingers to make or manipulate, in any way ; it exists in every human being, and it may be brought out to an extraordinary degree in the young, as has been fully tested and proved. Now, if we take two children of the same age, sex, and capacity, both going to the same school and pursuing the same studies, and if one of the two devotes from two to four hours a week to an industrial art class (*i.e.*, studying simple original *design*, easy wood-carving, repoussé, embroidery, &c.), it will be found—as it has been by very extensive experiment—that the latter child will at the end of the year excel the former in *all* branches of learning ; that is to say, in arithmetic or geography, so greatly does ingenuity proceed from the fingers to the brain. Now, mending is so nearly allied to all the minor or mechanical arts, it enters into them so closely, that it in a manner belongs to and is an introduction to them all. Like them, it stimulates invention or ingenuity, and is perhaps of far greater practical utility or direct use. Boys and girls learn very willingly how to mend, and, from a long experience in teaching them, I should say that a class with experiments and practical instruction in what is given in this book should take precedence of all carpentry, metal-work, joining, leather-work, or any other branches whatever. For it is *easier* than any of them, and it is of far more general utility, as the following pages clearly show. Such teaching would cost next to nothing for outfit, and would be the best introduction to technical education of all kinds.

There is an immense amount of breakage in this

world, yet, as a French writer on the subject observes, there are more great artists than good *menders*; the latter being so extremely rare that proofs of it are seen in bungling restorations in every museum in Europe, and in the almost impossibility of finding (out of Italy) men who can perfectly mend first-class ceramic ware. We see this ignorance in reproductions of delicate ivory ware coarsely cast in gypsum, and in a vast rejection and destruction of antiquities in wood, stone, or ceramic ware, simply because they are most ignorantly supposed to be beyond repair when they might, with *proper knowledge*, be very easily and cheaply restored, to great profit. And if the reader will visit the "dead rooms" of any museum in Europe and then study this book, he will find ample confirmation of what I say.

And here I would mention that every collector or owner of any kind of works of art, of *bric-à-brac*, or curiosities, who will master the art of mending, can find an illimitable field for picking up bargains in almost every shop of antiquities in Europe, especially in the smaller or humbler kind. For it is very far from being true that these dealers know "how to mend everything;" on the contrary, I have often found them very ignorant indeed of mending, and have frequently instructed them in it. Thus I now have before me a "Holy Family" of the early sixteenth century, bas-relief in stamped leather, twelve inches by eight, for which I paid two francs, but which I might have had for one, it being utterly dilapidated, and apparently of no value. In two or three hours I restored it perfectly, and it would now sell for perhaps a hundred francs. By it hangs a

"Madonna and Child," painted on a panel, gold ground, fourteenth century, which, including a very broad and remarkable old frame, I purchased both for twelve francs. The panel was warped like a sabre, ⌣⌣, the colour and *gesso* ground badly scaled away in many places. It was split in two pieces ; in short, it appeared to be nearly worthless. Now it is in very good condition, and would be an ornament to any gallery. As regards repairing ceramic ware or china, glass, and porcelain, art has of late years made remarkable advances, this kind of mending being the most in requisition. As for old carved wood, no matter how badly broken it may be, eaten away by worms, or rotten, or even wanting large pieces, so long as its original form is evident, it can be *very easily* repaired or restored to all its original beauty and integrity, as I shall fully explain. In this alone there is a vast field for investment or money-making, because there are annually destroyed almost everywhere quantities of old wood-carvings ; for, being badly worm-eaten, they are ignorantly supposed to be irreparable. The same may be said of ancient carved ivories, which are ready to drop at a touch into dust, as were those from Nineveh in the British Museum, yet which are now firm and clear. It is also true of the bindings of old books, many of marvellous beauty, whether of stamped leather, parchment, or carved. Even more interesting and curious is the repairing or restoring worm-eaten manuscripts or papers of any kind, or parchment, the easy process of filling the holes not being known to many bibliophiles. This art is becoming known in Germany, where it is not unusual to buy an old book for a

mark, rebind it in hard old parchment, repair it generally for two or three, and then sell it, according to the subject, for several hundred or thousand per cent. profit.

It is greatly to be regretted that it is so little known, especially in England, that to repair a few holes or restore a little broken, crumbling carving it is not absolutely necessary to tear down an entire Gothic church and build a new one, as is so very generally the case. There is no stone-work, however dilapidated it may be, which cannot be mended very perfectly, and that in almost all cases with a material which sets even harder than the original, as was perfectly shown at the Paris Exhibition of 1889. Dilapidated stone carved work, of all ages and kinds, which could be perfectly restored to a degree which even very few artists suspect, abounds in Italy, where it can be purchased for a song. The song, it is true, is generally sung to a small silver accompaniment, but the purchaser may make it golden for himself. For very few know how to restore a knocked-off nose so that the line of juncture be not visible ; yet even this is possible, as I shall show. And I may here remark that in all the first galleries and museums of Europe, without one exception, there is abundant evidence to prove that, of all the arts, the one of repairing and restoring is the one least understood and most strangely neglected.

There is hardly a village so small that one man or woman could not make in it or eke out a living by repairing different objects. In towns and cities the demand for such work is much greater, for there ladies break expensive fans and jewellery, and children

their dolls and toys, for mending of which the "rehabilitators" require "much moneys," especially in the United States, where prices for anything out of the way are appalling.

I would therefore beg all people who are gifted with some small allowance of "ingenuity," tact, art, or common-sense to consider that Mending or Restoring is a calling very easily learned by a little practice, and one by which a living can be made, even in its humblest branches, as is shown by the umbrella-menders and chair-caners in the streets. But common-sense teaches that any one who shall have mastered all that is explicitly set forth in this book ought certainly to be able to gain money, even largely ; for, as I said, the opportunities of purchasing dilapidated works of art, mending and selling them, are innumerable, and Restoration is as yet everywhere in its mere rudiments and very little practised. That which might be a very great general industry of vast utility, employing many thousands now idle, only exists in a hap-hazard, casual way, as dependent on other kinds of work. But to me it appears as a great art by itself, dependent on certain principles of general application. And when we consider what is generally wasted for want of proper knowledge of this great art, it seems to me to be but rational that if we had in London a school for teaching mending and restoring in all its branches as a trade, with a museum to show the public, probably to its great astonishment, what marvels can be wrought by renewing what is old, it would be of great service to the country at large. A very little reflection will convince the least visionary or most practical reader that what is wasted

or annually destroyed of valuable old works, which cannot be replaced, because they are no longer manufactured, if restored, would form the basis of a great national industry. It has not as yet, however, entered into the head of any one to conceive this, simply because no one has ever been educated as a general restorer, but only in a secondary, supplementary, small way as a specialist, generally as a botcher. And I maintain, from no inconsiderable knowledge of the subject, that the best menders and restorers by far are those who understand the most branches of their calling. The reason for this is plain ; it is because a repairer, when he comes to some unforeseen difficulty—for example, in mending china—and finds the cements used are not exactly applicable, he will, if sensible, think of some other adhesive used in other kinds of work, or other combinations or appliances.

I go so far as to say that an exhibition of specimens showing all that can be done in mending and restoration in ceramic art, leather, carved stone, books, carved and wrought wood, castings, metal, furniture, fans, and toys, would probably serve as sufficient beginning to establish classes and a school. The objects should, when possible, be accompanied by a duplicate or photograph showing the condition they were in before restoration, on the principle of the picture-cleaners, who amaze the public with such startling contrasts of dirt and splendour.

How this can all be done will be found in this book, which I venture to suggest will often be found useful in every family, or wherever "things" are broken and worn. For the collector of curiosities who would

willingly pick up bargains, I seriously and earnestly commend it as a *vade mecum* by means of which he may literally make money in any shop. For, as I have already said, strange as it may seem, the small dealers in *bric-à-brac* are generally very ignorant of all the curious secrets of restoration, or else they have no time or means to attend to such work. Again, if the collector has learned what I here teach, he will often detect restoration allied to forgery in expensive antiques, guaranteed to be perfect. It has been well observed by M. Ris-Paquot, in his valuable work, *L'Art de restaurer soi-même les Faïences et Porcelaines*, that it often happens, most unfortunately, that precious relics whose value is immense, such as the Italian *faïences* and those of Palissy or Henri II., come to collections in such a condition, so pitifully injured, that *de visu* we cannot buy them because we know of nobody who can actually restore them, and because this delicate work requires so much special knowledge. Add to this, that their great value and rarity disincline us to trust to the first-comer, or general workman, treasures which he might utterly ruin by clumsiness or ignorance.

I may add that I seldom walk out in Florence without seeing old worn *faïences* for sale for a mere trifle which with a little retouching, gilding, and firing could be made quite valuable. In such instances there need be no complaint of destroying the venerable effect and value of antiquity. In them antique material may be legitimately employed as a basis for newer work, especially when it is broken away, worn down to the core, or full of holes. Now, with what this book teaches in his mind, the artist or

tourist will very soon realise, if he be at all ingenious, or can avail himself of the aid of some friend who has even a very slight knowledge of art, that he can at a slight outlay purchase objects which will become very valuable when afterwards restored at home.

As I can imagine no head of a family, and no dealer in miscellaneous works of art or any small wares, no provider of furniture or furnisher, to whom this work will not be a most acceptable gift, so I am very confident that every traveller who has trunks to mend or broken straps to join, and every emigrant roughing it in the forests or the bush of Australia or Canada, may learn from it many useful devices, and the fact that with nothing more than a small tin of liquid glue and another of indiarubber he can effect more than could be imagined by any one who has not studied the subject. On this I speak not without experience, having found that, both as a soldier and a traveller in the Wild West of America, my knowledge of mending was of great use to my friends as well as myself. A perusal of the Index of what is here given will satisfy the reader that this manual is in fact a *vade mecum* for almost all sorts and conditions of men and women, and that there are none who would not be thankful for it.

A friend adds to these remarks the suggestion that this work may properly be included among the presents to a bride as an aid to housekeeping ; and it will probably be admitted that it would prove quite as useful as many of the gifts which are usually bestowed on such occasions.

I have truly said that, while breaking and decay

are universal, there are literally nowhere any generally accomplished repairers—that is to say, experts who know and can practise even what is set forth in this book. Certain menders of broken china there are, of whom the great authority on fictile restoration, Ris-Pasquot, declares that none can be trusted with anything valuable. There are so few needlewomen who can sew up a rent perfectly that a lady "to the manor born" paid in Rome *two pounds*, or *fifty lire*, for being taught the stitch, described in this book, by which it can be done. That it was a great secret to an expert and accomplished needlewoman proves that it cannot be generally known. A house-furnisher in London doing a large business once explained to me with manifest pride how he had, by dint of persuasion and treating, obtained from another what is really one of the simplest recipes for restoring a brown stain. All of this being true, it is apparent enough that any accomplished mender and restorer, lady or gentleman, can hardly fail to make a living by the art ; and I sincerely believe that it is the simple truth that it is set forth in the following pages so fully and clearly that any one who will make the experiment can learn from it how to make a living. This is effectively, in all its fulness, a new art and a new calling, and it is time that it were established.

It is a great mistake to suppose that manufacturers are necessarily good menders of what they make. I have found, as have my readers, that it is not the great watchmaker who oversees the production of thousands of watches to whom a watch can be most safely trusted for rehabilitation. For, in nine cases

out of ten, it is some extremely humble brother of the craft, who does nothing but mend in a small shop, who restores your chronometer most admirably. The same is true as regards trunks anywhere out of England, since in Germany and France anything of the kind is invariably botched with incredible want of skill. This runs through most trades ; for which reason I believe that a really well-accomplished general *mender*, earnestly devoted to the calling in every detail and resolved to be perfect in it, could ere long repair better than most manufacturers, since the latter, in these days, all work by machinery or by vast subdivision of labour, and not, so to speak, by hand. But all repairing *must* be by hand. We can make every detail of a watch or of a gun by machinery, but the machine cannot mend it when broken, much less a clock or a pistol !

The value of this book will appear to any one who knows how little really good repairing there is in Europe. Since writing the foregoing pages I have gone through the galleries of the Vatican and many other museums, and been amazed at the coarse, ignorant, and bungling manner in which the *great majority* of antique statues and other objects of immense value have been mended up. There is in most cases no pretence whatever to conceal the lines of repair, and when this has been attempted it has failed through ignorance of recipes and instructions which may be found in this work.

A MANUAL OF

MENDING AND REPAIRING

MATERIALS USED IN MENDING

> "*There are full many admirable and practical recipes* (Hausmitteln), *which are often known only in certain families.*"—Die Natürliche Magie. By JOHANN C. WIEGLEB, 1782.

THE art of mending or of repairing may be broadly stated as being effected, firstly, by mechanical processes, such as those employed by carpenters in nailing and joining, in embroidery with the needle, and in metal-work with clumps, or soldering ; and, secondly, by chemical means. The latter consist of *cements* and *adhesives*, which are, however, effectively the same thing. This glue, or gum, is an adhesive or *sticker;* that is, a simple substance which causes two objects to adhere. The same, when combined with powder of chalk or glass, would be a CEMENT. This latter term is again applied somewhat generally and loosely by many, not only to all adhesives, but also more correctly to all soft substances which harden, such as Portland cement, mortar, and putty,

and which are often used by themselves to form objects, such as "bricks" and castings; but these latter, having also the quality of acting as adhesives or stickers, are naturally regarded as being the same.

As will be speedily observed in the great number of recipes for mending which will be given in this book, there are many which occur frequently in different combinations; therefore it will be advisable and indispensable for those who wish to master mending as an art to indicate these as a basis.

As SIGMUND LEHNER has observed in his valuable work on *Die Kitte- und Klebemittel*, there have been such vast numbers of recipes published of late years for adhesives in various technological works, that the combination of the usual materials depends almost on the judgment of the experimenter, and every practical operator will soon learn to make inventions of his own. These materials, according to STOHMANN, may be classified as follows :—

I. Those in which OIL is the basis.
II. Resin or pitch.
III. Caoutchouc (indiarubber) or gutta-percha.
IV. Gum or starch.
V. Lime and chalk.

LEHNER extends the list as follows into adhesives, or cements :—

For glass and porcelain in every form.
II. For metals not exposed to changes of temperature.

III. For stoves and furnaces, or objects exposed to heat.

IV. For chemical apparatus and objects exposed to corrosive liquids.

V. Luting or cements, to protect glass or porcelain vessels from the action of fire.

VI. Cements for microscopic preparations, for filling teeth and similar work.

VII. Those for special objects, such as are made of tortoise-shell, meerschaum (ivory), &c.

Oils are divided into those (such as olive) which never become hard, and the linseed, which in time dries into a substance like gum. The latter combined with a great variety of mineral substances, such as plumbago, calcined lime, magnesia, chalk, red oxide of iron, soapstone, or with varnishes, forms insoluble "soaps," which, as cements, resist water. They require a long time to *set* or become hard.

Resins and Gums include a great number of substances, such as resin or hard pitch, which is distilled from pine-trees ; shellac, mastic, elemi, copal, kauri gum, amber, gum arabic, dextrine made from flour, the gum of the peach and cherry, and of many other trees. To these may be added frankincense and tragacanth, which is less an adhesive than a stiffener and dresser. Gums are generally rather brittle ; this is remedied by combination with oily substances, volatile oils, or caoutchouc. With these gums Lehner includes asphaltum. The defect of such adhesives is, as he also remarks, that they will not resist *high* temperatures. This, however, will apply to most objects.

VARNISH.—This belongs properly to the gums, but is technically regarded as a separate material. It is gum in solution in turpentine or spirits. For details vide *Die Fabrikation der Copal- Terpentinöl und Spiritus-Lacke*, by L. E. Andés ; Leipzig, price 5 m. 40 pf.

CAOUTCHOUC and GUTTA-PERCHA are gums which when hard are still elastic, and resist the action of water. I have read that a perfect imitation or substitute for them has been made of turpentine, but have not seen it, though I have met with glue made with oil and turpentine, which very much resembled them in elasticity or flexibility. Reduced to a liquid form with ether, benzine, &c., these gums can be kept in a liquid state for a long time, and then hardened in any form by exposure to the air. They enter into a very great variety of cements, such as are meant to be tough or waterproof. Indiarubber is, on the whole, the best, and gutta-percha the cheapest, for cements.

GLUE.—This is made, by boiling, from horns and bones ; it is essentially the same as gelatine. It is the most generally known of all adhesives, and may be modified by certain admixtures to suit almost any substance. It has the peculiarity that it must always be boiled in a *balneum mariæ*, or in a kettle in hot water in another kettle. Its strength is vastly increased by admixture with nitric acid or *strong* vinegar. On the subject of glue in all its relations, the reader may consult *Die Leim- und Gelatine-Fabrikation*, or " The Manufacture of Glue and Gelatine," by F. Dawidowsky ; Vienna, price 3s.

FLOUR-PASTE AND STARCH-PASTE.—These mixtures, though generally used for weak work, such as to make papers adhere, can be very much strength-

ened by admixture with glue and gums. Combined with certain substances, such as paper, mineral powders, and *alum*, they, when submitted to pressure, become intensely hard, and resist not only water but heat, when not excessive. Also combined with varnishes they are decided resistants. LEHNER speaks of them as if they were perishable in any condition.

STURGEON'S BLADDER.—With this the bladders of several kinds of fish are classed. Cut in small pieces and dissolved in spirits it makes a very strong adhesive, which is mixed with many others.

LIME is the most extensively used cement in the world. Combined with water it forms mortar. It is united with many substances, such as caseine or cheese, the white of eggs, and silicate of soda, to make powerful minor cements. On the subject of lime the practical technologist should consult *Kalk- und Luftmortel*, by Dr. Herrmann Zwick ; Vienna, A. Hartleben, price 3s., in which all details of the subject are given in full.

EGGS.—The yolk, and more particularly the white, of eggs is sometimes used as an adhesive, and it enters into many very excellent cements. For details as to the chemistry and technology of this material consult *Die Fabrikationen von Albumin- und Eierkonserven* (A Full Account of the Characteristics of all Egg Substances, the Fabrication of Egg, and Blood Albumen, &c.), by Karl Ruprecht ; Vienna, A. Hartleben, price 2s. 3d.

NEUTRAL SUBSTANCES, OR BINDING MATERIALS.—Almost any substance not easily soluble in water, and many which are, from common dust or earth, or clay, sand, chalk, powdered egg-shells, sawdust,

shell-powder, &c., when combined with certain adhesives, form cements. This is sometimes due to chemical combination, but more frequently to mechanical union. In the latter case the adhesive clinging to every separate grain has the more points of adhesion, just as a man by clinging with both hands to two posts is harder to remove than if he held by one.

Caseine or Cheese.—This in several forms, but chiefly of curd in combination with several substances, but mostly with lime or borax, forms a very valuable cement. It is also combined with strong *lye* and silicate of soda. It must not, however, be too much depended on as a resistant to water or heat.

Blood, generally of oxen or cows, combined with lime, alum, and coal ashes, forms a solid and durable cement.

Glycerine forms the basis, with plumbago, &c., of several cements. Like oil, it renders glue flexible and partly waterproof. For chemical details on this subject, vide *Das Glycerin*, by J. W. Koppe, Leipzig.

Gypsum is combined with many substances to form cements, some of them of great and peculiar value.

Iron pulverised is the basis of a great number of very durable and strongly resistant cements.

Alum may be included among the bases, as it is very important in several compositions, forming a powerful chemical aid. It is excellent as aiding resistance to both moisture and heat. For an exhaustive work on alum consult *Die Fabrikation des Alauns*, &c., by Frederic Junemann, which should be carefully studied by all who work in cements.

There is a very great number of "indifferent" or minor aids to these, such as sugar, milk, honey, spirits

of wine, water, ochre, galbanum, tannin, ammonia, feldspar, plumbago, sulphur, vinegar, salt, zinc (white), umber, bismuth, tin, cadmium, clay, ashes, &c., which are essential in certain combinations.

DEXTRINE, the gum of flour or starch, or *Leiokom*, much resembles gum-arabic, but is more brittle. Its adhesiveness depends somewhat on the manner in which it is dissolved. "It is," says LEHNER, "prepared by heating starch which has been moistened with nitric acid ; also by warming paste with very much diluted sulphuric acid."

WAX, including that of bees as well as paraffine, is used in repairs, and forms a part of several cements. On this subject consult *Das Wachs*, or "Wax and its Technical Applications," by Ludwig Sedna ; Leipzig, 2s. 6d.

SILICATE OF SODA, OR LIQUID GLASS.—This is generally sold in the form of a very dense liquid. It is prepared by mixing quartz or flint sand with soda, or more rarely with potash. "It is," says LEHNER, "a glass which is distinguished from other glasses by being easily soluble in water. It is believed to be a very modern invention ; but I have seen Venetian glasses of the fifteenth century which appeared to be painted with it, or something very similar ; and I have found decided indications of a knowledge of it in two writers of the sixteenth century, WOLFGANG HILDEBRAND and VAN HELMONT. According to Wagner, there are three kinds of liquid glass. By itself liquid glass can only be used for mending glass ; but when combined with other substances, such as cement, calcined lime, or clay, or glass, in powder, it forms a body as hard as stone, or a double silicate, which is

strongly resistant to chemical influences.'' It occupies the first position as an adhesive for glass, nor is it surpassed as a cement in solid form. On this subject vide *Wasserglas und Infusorienerde*, &c., by Hermann Krätzer ; Vienna, 3s.

Natural Cement, or Hydraulic Lime.—This is familiarly known to all readers as Portland cement, but it is found of different qualities in many countries, and is also made artificially. Certain mineral substances have the quality when powdered and combined with water of setting hard as stone ; hence the name *hydraulic*. I have seen at Budapest articles of Portland cement made in Hungary which equalled in appearance fine black slate or marble, and, while much less brittle, were indeed in every respect more durable and resistant to exposure. These artificial cements can be largely incorporated with indifferent substances, such as sand ; they, however, require intense baking, and may in consequence be regarded as a kind of fictile ware.

Portland cement is very thoroughly treated in *Hydraulischer Kalk und Portland Cement* (in all their relations), by Dr. H. Zwick.

Tragacanth, though called a gum, is properly nothing of the kind, not being a true adhesive. It is the product of the *Astragalus verus*, a tree found in Asia. It swells out in water, and softens, but without dissolving. It is more of a glaze than a paste ; hence it is used extensively by confectioners, bookbinders, or to stiffen laces. It enters, however, into the composition of several cements.

Bread may be classed as a material by itself, as it

derives certain peculiar virtues from the yeast which causes its fermentation. With certain combinations it becomes wax-like, or hard, and may be used to advantage in many repairs as well as for modelling. It has the great advantage of being easily worked and always at hand.

Celluloid is treated of in this work under the head of Artificial Ivory. It is made from gun-cotton and camphor. For full information on this subject consult *Das Celluloid*, or "Celluloid, its Raw Materials, Manufacture, Peculiarities, and Technical Applications, &c.," by Dr. Fr. Böckmann, Vienna and Leipzig.

Potatoes, peeled and mashed, and kept for thirty-six hours in a mixture of eight parts of sulphuric acid to a hundred of water, and then dried and pressed, form a white, hard substance very much like ivory, or, as one may say, like white boxwood. Lehner expresses his doubt as to whether artificial meerschaum pipes were ever made of this substance, but I have seen them, and can testify that they looked like meerschaum, and certainly were much harder than *bruyere*, or briar-wood. Whether they will "colour" I cannot say.

The principle by which potatoes, paper, and many other substances can be hardened like parchment or horn is curious. Potatoes consist of about seventy per cent. water and twenty-five per cent. of starch, the remainder being salts and *cellulose*, which forms cells surrounded by the grains of starch. "When such a substance is for some time brought into contact with diluted sulphuric acid, that which results is simply a contraction of the cells" (*i.e.*, a hardening),

"or a kind of parchmenting." Thus soft paper is converted into parchment.

It is evident that chemistry is as yet in its infancy as regards the conversion of cellulose by acid into hard substances. Since cotton, paper, and potatoes all produce by this process different substances, it is probable that hundreds of organic, or at least vegetable, substances will all yield new forms.

There is a marked difference between paste made of *starch* or *flour*, each having its peculiar merits. The former is principally prepared from potatoes. To prepare the cement we mix it with a very little water, stirring it very thoroughly till it assumes a bluish appearance. A little more hot water is then added, and the mass left till an opal-like tinge indicates that it has formed. To this then add hot water *ad libitum*. As it is almost colourless in very thin coats, it is largely used to glaze and give body or weight to, and often to simply falsify, woven fabrics, which by its aid seem heavier. To increase this weight white lead and other substances are used.

To make the best flour-paste, flour should be kneaded in a bag under water till all the starch is washed away. What remains is a substance closely allied to caseine, or the white of egg. Combined with lime it forms a hard cement. A very slight admixture of carbolic acid (also oil of cloves) will keep paste from souring or decay. This acid has the property of destroying the growth of the minute vegetation which constitutes fermentation, just as other strong scents or perfumes are supposed to disinfect rooms, &c.

A very great number of other ingredients, such as the oxides of lead or zinc, manganese, baryta, sul-

phur, sal ammoniac, flint-sand, clay, salt, ochre, varnish, galbanum, or frankincense, enter into certain recipes, but those already given may be regarded as constituting by far the principal portion of all cements in ordinary use.

MENDING BROKEN CHINA, PORCELAIN, CROCKERY, MAJOLICA, TERRA-COTTA, BRICK AND TILE WORK.

FICTILE or Ceramic ware embraces, roughly speaking, all that is made of clay, or mineral bases or materials, and which is subsequently baked to give it hardness. The better the material and the more intense the heat, or the greater the number of bakings to which most kinds are subjected, the harder and more lasting will they be. The old china ware which preceded porcelain, a great many specimens of old Roman vessels, and, for a more modern example, old Italian majolica and Hungarian wine-pitchers, made all within a century, are as hard as stone. They chip a great deal before they break, just as agate might do.

TERRA-COTTA is simply earth or clay "baked." In most of the examples known as terra-cotta, earth predominates. Pure fine clay well fired is superior to what is generally called terra-cotta. Neither can we really class with it articles made of superior Portland cement, of which, as I have said, I have seen many made at Budapest which were like the finest hard slate.

Many writers confuse majolica with faïence ; others regard the latter as what we should call crockery, or such ware as ranges between glazed terra-cotta and porcelain.

MAJOLICA consists generally of terra-cotta covered with a glaze. A glaze is a fusible substance, we may say a kind of glass, mixed with colouring matter, which is at the same time a protection and an ornament. Enamel is glass in fine powder melted, used generally on metal or by itself. The base of the paint is a substance fusible by heat which is mixed with colours also fusible. Therefore when the painting is submitted to heat it melts, adheres, and is permanent. Glazing, enamelling, and china painting are essentially the same.

Terra-cotta is not difficult to mend. I can best illustrate this by an example. A friend once gave me a terra-cotta vase from the Pyramid of Cholula, in Mexico. These are supposed to be of very great antiquity. This contained a fragment of pottery, probably a sacred relic of ruder style, and I suppose of far earlier times. The vase, however, had been broken to fragments, and the owner was about to throw it away as worthless. I begged it of him. Firstly, I put the principal pieces together, using, to make them adhere, glue with nitric acid. For finer work I should have used Turkish cement or the best gum-mastic dissolved in spirit or fish glue. Piece by piece with care I reconstructed the whole.

There was wanting, however, one piece about three inches square. I pasted with great care a piece of paper inside the vase for a *back*, and then poured on it plaster of Paris liquefied with water. To make this *set* hard, the plaster or *gesso* should be made with burnt alum-water and dissolved gum-arabic. This exactly supplied the missing piece.

When it was finished, I filled in all the broken edges

and other cavities with the plaster-paste, which set even harder than the terra-cotta. The outer colour of the vase was of reddish rusty black. I painted the whole over with a corresponding colour ; that is to say, I rubbed it in by thumb, which is very different from mere painting. By cementing and rubbing I so restored the whole that the repair was hardly perceptible. This process is carried to great perfection in Italy with broken Etruscan ware.

I may here remark as regards *rubbing in* oil or water colours, that it is little known or practised, but it is of great value in restoration when we wish to produce certain curious antique-looking effects. I once knew in Rome an artist who had bought for a trifle an old carved *baule* or chest. By rubbing in with care on it Naples yellow and brown shades, and subsequent friction, he had made it look strangely like old ivory. Mere painting, however skilfully performed, would not have given it its antique ivory look. The same artist had purchased one or two common, large, yellowish terra-cotta wine-jars. He drew on them classical figures, cut out the outlines a little with chisel and file, and smoothing the figures with sandpaper, also ivoried the whole by *rubbing in* colour. This was but a few hours' work, yet the effect was startling. What had cost but a few francs would have sold for hundreds. I should add that with the aid of fine retouching flexible varnish this process could be very much facilitated. Any one who can draw or paint at all can try this experiment on any old piece of wood-carving, or on a common yellow coarse earthenware. Smooth the latter first with sandpaper, then rub in

the colours. The same is applicable to old carving in marble.

All of these devices are of use to the restorer. As regards restoration of terra-cotta, the field is wide and profitable. Not only in Italy, but even in London, we may find for sale broken Etruscan vases or similar objects for a trifle, which are extremely easy to restore. These are generally of red or light yellow clay baked. If you have, let us say, a vase fractured, obtain clay of the same colour—if you cannot readily get it, take pipeclay—and colour it with a strong infusion of red or yellow, though this is not necessary if the exterior is black. Mix the clay well with glue or gum-arabic and alum-water, supply the missing portions, and let them harden. With a little care and practice, remarkable restorations may thus be made. I may here add that with this composition, bottles, decanters, and cups can be coated, which, when painted or rubbed in, exactly resemble Etruscan or other ancient pottery. To prevent cracking, they should first be painted with thick, coarse oil paint mixed with sand or umber, which forms a ground. Let it dry—the longer the better—and then rub in, thinly, the gum and clay. There is another composition of *blanc d'Espagne*, or whiting, and silicate of soda, which sets even harder, but which is a little more difficult at first to work, which may be used for such restoration. This can be directly painted on glass for a ground.

Majolica or *Faïence* can generally be sufficiently well mended with acidulated glue, but as the latter often communicates a dark stain, it is better to use for fine ware, or any which is to be used, the so-called Turkish

cement. The best quality of this is made of the finest quality of gum-mastic dissolved in spirit. It is so tenacious that in the East gems are frequently directly attached by means of it to metal, and they will often break sooner than separate from it. Most chemists have for sale, or will prepare for you, some form of it. The silicate of potash and whiting can also be supplied by chemists ; they should be mixed with great care, so as to form a medium paste, and then used rapidly and with skill, because this cement hardens very quickly. It is, however, a very powerful binder, and sets as hard as glass.

Having put together and cemented the broken pieces of a cup or vase, they must be kept in place till the cement dries. This is effected by means of many contrivances, regarding which the operator must employ *some* original inventiveness. Firstly, the pieces can often be simply tied, or attached by pieces of tape, or parchment, or paper glued on. In other cases india-rubber bands are useful. Again, bits of wood, or sticks and wires, are the things useful. A bed of wax is generally a sure guard. It is best to do this with great care, and not impatiently rely on holding the pieces together with the fingers till they stick. This is often the most difficult part of the whole operation ; therefore it should be done well and deliberately. And here it may be remarked that, as in surgery, the most complicated cases of fracture may be studied out and adjusted ; for which reason I dare say that skilful surgeons would be good menders of crockery, just as good astronomers are always good riflemen.

When the broken pieces are adjusted and all is dry,

there remain the chips, hollows, ragged edges, and "hairs," as the French call them, or lines of juncture, to be filled and smoothed. This is done with the cement which you employ, according to the quality of the material, either plaster and gum-arabic, silicate and whiting, or powdered chalk. Some experts succeed with white of an egg and finely powdered quicklime, which holds firmly, but which requires practice to amalgamate. Fill the cavities carefully, pressing the cement well in, as the Romans did, with a stick or point. When all is smooth, paint over the blank spaces and varnish with Sohnée, No. 3, or with a slight coating of silicate. Fine copal varnish is rather tougher or less brittle.

The most thorough process of all is to unite the fragments with a vitreous or metallic *flux*, such as the silicate—there are several of these—and then have the work baked or fired. It can then be painted with porcelain colours under glaze, and fired again. As this is very delicate, difficult, and expensive, few amateurs will care to try it. It is, however, perfect, and by means of it the most complete reparation can be effected. The Japanese do this simply with the blow-pipe, by means of which they fix enamel powders even on wood. This use of the pipe is also difficult, but the ancient Romans are said to have employed the process with most minor work. As a thread of glass will melt in a candle, and as fine-glass powder is equally fusible, it can be understood that under the flame of a blow-pipe the latter can often be melted so as to avail in restoration.

Crockery, or Faïence, and Porcelain.—"Crockery," by which we commonly understand such ware

as that of the blue willow plates, is far superior to terra-cotta, since its *core* or basis is thin, and very hard, and its gloss of a different description, and more incorporated with the body ; or it is of a single superior body.

Porcelain differs entirely from the other two kinds of fictile ware, being an elaborate mineralogical compound, its base being *kaolin*, a friable, white, earthy substance, requiring great care in its preparation, and *petunse*, or feldspar, which is united with the *kaolin*. The result is a very delicate and beautiful diaphanous ware, or one through which light passes to a limited degree. Both crockery and porcelain are far more difficult to mend, owing to the impossibility—particularly with the latter—of making fractures disappear.

The first and most simple process of mending both kinds of ware is to make small holes with a drill along the edges of the fracture, and then, adjusting the fragments, bind them together with wire. M. Ris-Paquot claims that "the honour of this discovery belongs properly to a humble and modest workman named Delille, of the little village of Montjoye, in Normandy." But the archæologist will say of this claim, as the English judge did of a similar one, that the plaintiff might as well apply for a patent for having discovered the art of mixing brandy with water, since there was probably never yet a savage who had wire, or even string, who did not know enough to mend broken calabashes, jars, and pipes by this solid method of sewing. From the time when large earthen punch-bowls were first used in Europe, we find them mended with silver wire. It is needless to devote whole pages with illustrations, as M. Ris-

PAQUOT has done, to show how to effect such mending. The holes are made with either a bore or hand drill, such as can be bought in every tool shop. If the reader will obtain one and experiment with it on any penny plate or broken fragment, he will soon master all the mystery. The wire is made fast by a turn with a pair of nippers or pincers. Before fastening, wash the edges of the ware with white of egg in which a very little whiting, or finely powdered lime or plaster of Paris, has been mixed.

I may here observe that the wire for china-drilling should be half round, or flat on one side. To prepare this, take brass wire, say a length of about two feet, and, holding an old knife, draw the wire firmly and steadily against it.

There are endless cements for sale by chemists, all warranted perfect, to mend glass and china, and most of them do indeed answer the purpose very well, for nature has given us not a few materials wherewith to repair accidents. Thus, even boiling in milk will often suffice to reunite broken edges. But I believe that of all, the Turkish cement already described, which is made of gum MASTIC (a term improperly applied in France to putty, by Americans to lime-plaster on houses, and by Levantines to spirit with resin in it), is the most adhesive and resistant to heat, cold, or moisture.

The art of mending does not consist so much of knowing what to use for an ADHESIVE (since, as I have said, every chemist's shop abounds in these) as in skill and tact with which fragments are brought and kept together, missing portions supplied, and in knowing the substance with which to fill a blank. There are

cases in which, when a hole has been knocked in a china or glass plate, it can be drilled out round, and a disc of the same substance or colour, or even of another, inserted. This is almost an art by itself, and by means of it very singular and puzzling effects may be introduced ; as, for instance, when a number of holes are drilled in a white china plate and then filled with discs of coloured china, agate, coral, &c. In the East, turquoise and coral beads are often thus set into porcelain, as well as wood. The mastic or acidulated glue is used to make the objects inserted hold firmly.

As the smoker, when he breaks his pipe across the stem, has it repaired with a short silver slide or tube, so when a china jar is broken across the neck, the reparation can be concealed by a silver collar, which is sometimes a great improvement ; as, for instance, when the head of a china dog, or even of a china man, is taken off. But in a great many cases, or in all where this kind of concealment is advisable, it may be made, like Cæsar's wife, beyond suspicion, by making the collar or concealing ornament, or leaf or flower, of silicate and whiting so as to resemble the ware itself, which can be done very nicely.

Silicate of Soda is sometimes sold in the form of a dry solid, which is placed in a little vinegar, and warmed. When dissolved it can be used *ad libitum*. It is often used as a glaze for stone.

There is a curious old story about mending broken crockery by means of magic—or rather by deceit—which, though not of a practical nature, is at least amusing. It is partially told in a book published about 1670, entitled *Joco-Seriorum Naturæ et Artis Magiæ Naturales Centuriæ Tres*. It happened once in

Mergentheim that there was a great fair, when the whole courtyard of the palace was full of earthenware vessels for sale *ab assidentibus muliebibus* (by attendant women). Seeing this, the Prince of Mergentheim went about among these women, and so arranged it that they divided all their stock into two parts, or exact duplicates, half of which they hid away, while the other half was exposed for sale. While at dinner the Prince spoke much of magic, and professed to be able to produce such a delirium in people's minds that they would act like lunatics. "Thus, for instance," he said, pointing casually out of the window, "you see all those women. I can drive them mad at once." Whereupon one who was present wagered a handsome carriage and four horses that the Prince could not do it. The latter smiled, waved his hand, and uttered a spell, when lo! all at once the market-women began, *bacchantium more*—like raging Bacchantæ—to attack their crockery with sticks and stools, and hurl it about, and dash it to pieces.

The one who had betted the chariot protested that it was a trick arranged beforehand. The Prince replied, "Well, the pots are all broken. If I can mend them again by a spell, wilt thou then believe?" The other said, "Most certainly." Then the Prince waved his wand and said, "It is done. Let us go down into the courtyard and see." And when there, sure enough they found the pots all whole again—at least they discovered others exactly like them in their places.

The legend continued that the Prince, though he kept the carriage and horses as a trophy, liberally paid for them. The author of the *Tres Centuriæ*, who

does not record the secret of the little arrangement, declares that he does not know whether it was all done by a fraud or by magic. If it was the latter, I regret that the incantation by which broken crockery is mended is now lost. The most powerful spell known to me is *Recipe Gummæ Mastichæ duæ unciæ cum Spirito Vini fiat mixtio*—that is, mastic cement. It is generally combined with sturgeon's bladder glue.

This cement answers very well for glass. One of the old recipes, which was very good indeed, is thus given by JOHANNES WALLBURGER (1760) :—"Take finely cut and a little powdered sturgeon's bladder" (still sold by all chemists), "soften it all night in spirits, add to this a little clean and powdered mastic, boil it a little in a brass pan. Should it become too thick, add a little spirits." This may be also used for many other purposes.

A strong but coarser adhesive, especially for crockery and stone, can be made as follows :—Take old and hard goat's milk cheese, and warm it in hot water till it forms, by pounding, a mass like turpentine. Add to this, while grinding, finely pulverised quicklime and the well-shaken white of eggs.

I do not hesitate to give a variety of such recipes, because in every one the artist will find valuable suggestions for other purposes than simply glueing broken articles together. This latter is a valuable "filler" for many purposes. Glue was formerly made into a strong cement by boiling it for a time in water, but before it had become incorporated with the water, the latter was poured off and strong spirits substituted and stirred well in.

A very popular old cement for crockery, of which

there were several variations, was made by mixing glue, turpentine, ox-gall, the juice of garlic, and sturgeon-bladder, tragacanth, and mastic. All of this singularly smelling mixture was put into a pan and boiled in strong spirits, such as whisky, then kneaded on a board under a roller, again boiled with more spirits, yet again rolled, and this was repeated a third time, and then cooled till it could be cut into cakes. When these were tc be used they were again steeped in spirits. But with this cement, glass or metal could be most firmly attached to wood. I confess that I have never tried it, but it was evidently a very strong cement.

Another of these somewhat complicated recipes for crockery, glass, and porcelain, which I find in the *Tausandkünstler*, 1782, is as follows :—Half an ounce of finely cut sturgeon's bladder, two teaspoonfuls of alabaster powder or gypsum, quarter of an ounce of tragacanth, one teaspoonful of silberglatt, two of powdered mastic, two of frankincense, two of gum-arabic, one of Marienglas, one tablespoonful of spirits of wine, one of beer-vinegar. Boil it and stir, and apply. Any drops sticking to the mended article may be removed with vinegar. When it is to be used again revive it by heating, adding spirits of wine and beer-vinegar. The gum-frankincense is here worth noting.

A common cement for mending broken glass or china is prepared as follows :—To two parts of gum-shellac add one of turpentine ; boil them over a slow fire, and form the mass into small cakes before it dries. To use it, warm with a lamp. To mend ivory or wood, take a cake and let it dissolve in spirits of wine.

A very strong cement is made as follows :—Take one ounce of finely powdered mastic dissolved in six of spirits of wine and two ounces of shredded sturgeon's bladder dissolved in two ounces common spirits ; add one half ounce of *gum-ammoniac* as it hardens ; warm it when it is to be used. This is as strong a cement as can be made.

Defects, cracks, and repairs in porcelain, &c., may often be concealed as follows :—Paint the spot with silicate of soda, not too much thinned, and dust it over before it dries with bronze powder. This will set so hard that it may be polished with an agate burnisher.

It is also possible that many of my readers have heard of *gesso painting*, an art perfected by Mr. Walter Crane. This consists of painting with plaster of Paris in solution, with the point of a brush, depositing the soft paste in relief. The same principle is applicable to painting in silicate and whiting on glass surfaces. By means of it decoration can be given to any glass bottle or other object.

Lime enters into the composition of many cements, the simplest being the mortar formed by its admixture with water. But the quality of this is very much determined by that of the lime. The *chunam* of India, which resembles white marble or a fine white stone, is made of sea-shells burned to lime. A wonderfully hard, fine, white cement used by the Romans for their best mosaic-work, and which set with great rapidity, was made of shell-lime with the white of eggs. I have found the same composition worthless when made with inferior stone-lime.

A good cheap cement for porcelain and glass is combined as follows :—

Starch or wheat flour . . .	8
Glue	4
Purified chalk	12
Turpentine	4
Spirits of wine	24
Water	24

Pour a part of the spirits and water mixed on the flour and chalk, add the glue, boil it down till the latter dissolves, and stir the turpentine into the whole. This can be used to make artificial wood with shavings or sawdust.

A very good cement for porcelain, and one which is colourless, is made by cutting the finest clear gelatine into bits, and dissolving it in vinegar of 50°, stirring it in a porcelain vessel until well mixed. When cold it will harden, but softens under the influence of heat, when it may be applied to the broken edges of the porcelain, which are to be pressed together. It will be perfectly hard within twenty-four hours. It is to be observed that the art of keeping such joined pieces together is the most difficult problem in mending. This cement is widely applicable to many objects, and also admits of considerable modification and additions, like all cements. As it is colourless, it may be combined with ivory dust, or white powders of baryta, magnesia, whiting, &c., to form artificial ivory with glycerine. With sturgeon's bladder it makes a still stronger cement.

Lehner observes that glue has the property, when combined with acid chrome salt (*sauren chromsalzen*), of losing its solubility when exposed to the light, so that it can be used as a cement for broken porcelain

and glass. If the juncture is to be invisible, take the purest white gelatine ; otherwise the cheaper gilder's glue will answer. To prepare the chrome glue, dissolve the gelatine or the glue in boiling water, then add the solution of double chromic acid alkali, or the red chrome alkali of commerce, stir it well up, and put it into tin boxes.

The formula is :—

Gelatine or gilders' glue . .	5–10
Water	90
Red chrome alkali . . .	1–2
Dissolved in water . . .	10

To use, warm the cement, apply it to the broken glass, which must then be exposed for several hours to the sunshine.

Cracked bottles are mended by a very ingenious process, described by LEHNER. The bottle is corked, but not tightly, and then exposed to heat about 100° centigrade. Then the cork is driven in tightly, which causes an expansion of the cracks, which are at once filled by means of a finely pointed brush with the silicate. Removed to a cooler place the glass contracts on the as yet fluid silicate, and the fractures are mended.

A VERY STRONG, CLEAN CEMENT FOR PORCELAIN OR GLASS is made as follows :—

Well-cleaned glass powder . .	10
" fluor spar powder .	20
Silicate of soda solution . . .	60

This must be very quickly stirred and applied. This is one of the *hardest* and best cements, and it resists heat and other influences so well that when very carefully amalgamated it may be applied to the manufacture of many useful articles. The same may be made with the substitution of white pipeclay for fluor spar, or with the addition of the same in somewhat larger proportion. Pipeclay or any good clay can also be combined with glycerine to prevent its drying. With gelatine and a *little* glycerine it will harden and not crack.

This requires careful amalgamation and rapid work.

To prepare very fine glass-powder for this cement, heat any glass till red-hot, then drop it into cold water. It may then be reduced in a mortar to an impalpable powder.

Earthenware tubes or pipes which are to be exposed to intense heat may be luted or joined with the following cement :—

Peroxide of manganese . . .	80
White oxide of zinc . . .	100
Silicate of soda	20

"This does *not melt*, save at a very high temperature ; and when melted it forms a glassy substance, which holds with extreme tenacity" (LEHNER).

To prepare *caseine* cement for crockery or marble, it may be observed that we should always take *fresh* white cheese and macerate or knead it thoroughly till only pure CASEINE remains. By adding to this one-third of powdered quicklime and blending the two ingredients very thoroughly we get a very strong

glue. An admixture of 10 parts silicate of soda also forms a powerful cement.

The following for tile-work and common brick-crockery, or terra-cotta or porcelain, is very highly commended by LEHNER, who says that anything mended with it will sooner break in another place than where it is cemented :—

Slacked lime	10
Borax	10
Litharge	5

The cement is mixed with water, and the tile or crockery, &c., heated just before being mended.

I cannot insist too strongly on this—that no one is to expect that by simply taking recipes, as written, compounding and applying them, there will be a successful result at the first trial. We must always have the best material, often fresh, and generally attempt the application more than once. *Perseverando vinces*—"By perseverance you will conquer." Not only must the *quality* of the ingredients used be of the best, but the composition be made exactly in the order in which they are given. The same substances often give very different results, simply because the order of combination in the two was different.

TO REPAIR PAVEMENTS :—

Calcined lime	10
Purified chalk	100
Silicate of soda	25

This hardens slowly. It can, when mixed with small sharp-edged fragments of broken stone, be used

to form pavements, or as a bed for mosaics. For the same purposes, or for cementing marble slabs, a cement known as that of BÖTTGER may be used. It is made thus :—

Purified chalk	100
Thick solution silicate of soda .	25

This becomes (LEHNER) in a few hours so hard that it can be polished. It is the principal, and almost the only, cement used by M. RIS-PACQUOT, or commended in his work on mending crockery. It admits of a great variety of modifications. It is very superior as a bed for mosaics of all kinds. It forms, like the preceding, also a good bed for scagliola and ceresa.[1] I would here say of the latter, that I could wish to see it more generally used for mural or wall ornament, since any one who can paint a face or decoration boldly and largely in oil or water colours will find it very easy. It admits of rapid execution, and is striking from its brilliancy. Everything in it depends on having a good bed to which it can easily adhere. I may here observe that beds like these which set hard and *fine* are also adapted to fresco-painting, in which the difficulty is to select colours which, when absorbed and dried, do not fade. Most paints made from mineral substances combine with silicate of soda.

I may here remark that a curious and easy art, very little known, consists of carving or cutting low reliefs on tiles or terra-cotta or brick-like ware, which, when

[1] *Ceresa* is the setting of powdered glass of different colours in a cement bed. Mosaic cubes are often combined with it.

outlined or in relief, can be glazed in colour with silicate of soda ; also with many other cements.

A common and good CEMENT FOR PORCELAIN OR GLASS is made as follows :—

Calcined gypsum or plaster of Paris.	50
Calcined lime	10
White of egg	20

This must be quickly mingled and rapidly used, as it sets very rapidly and becomes extremely hard. It makes an admirable bed for mosaics or ceresa.

When plaster of Paris is simply combined with burnt alum in water, the objects mended with it require several weeks to set or adhere. Gypsum combined with gum alone holds firmly, but does not resist water (vide *General Recipes*).

CEMENTS FOR LUTING or closing chemical apparatus :—

Dried clay	10
Linseed-oil	1

This endures heat to boiling-point of quicksilver.

A more resistant fireproof is as follows :—

Manganese	10
Grey oxide of zinc	20
Clay	40
Linseed-oil varnish	7

Of the oil only so much is needed as to combine the mass to a paste.

A LUTING for very high temperatures :—

Clay	100
Glass powder	2

Another CEMENT :—

Clay	100
Chalk	2
Boracic acid	3

LEHNER has in his work on Cements many valuable suggestions as to mending porcelain. *Firstly*, that in such mending, the adhesive be applied with care, in as even and as thin a coat as possible ; to which I would add, that the unskilful amateur is apt to daub it on irregularly and carelessly, with the impression that the more cement there is the better it will stick, which is just so far wrong that every superfluous grain is just so much of an impediment to good drying or adhesion. Again, the inexpert daubs it on with a stick or "anything," when a fine-pointed brush or hair-pencil should be used.

BROKEN CHINA WHICH IS TO BE MENDED should be carefully covered away so as to protect it from dust, which is hard to clean off. Beware of fitting the pieces together again and again, as is often done.

If the broken china was used to contain milk or soup, &c., it should be laid in lye to dissolve all the fatty substance, and then be washed with clear water. Painted porcelain cannot, however, be laid in lye, which would ruin all the colours ; in this case wipe them clean with dilute acid.

The great difficulty in mending is to bring the pieces together and keep them so till the adhesive dries. LEHNER recommends that when objects are small and costly, a mould of gypsum be constructed round them. In most cases putty or wax is far more manageable. As before remarked, indiarubber bands

are chiefly to be relied on; even if not capable of holding permanently, they aid greatly in tying with cord.

In the Manual of F. Goupil, rewritten by Frederick Dillaye, the following method of restoring broken vases, &c., is commended :—

"Form a solid mass of clay in the form of the original object. Then place on it, one by one, the fragments in their place, keeping the clay moist. When this is done, paste over the exterior strips of paper, in sufficient quantity to hold the whole firmly together. Then remove the moist clay, and paste strong slips of paper" (or thin parchment) "over the interior so as to hold the whole. Then" (when dry) "carefully moisten and remove the outer coating."

The author mentions that this is only applicable to vases the mouth of which is wide enough to permit the hand to be introduced. I would here, however, add, that even when it is too small for this purpose, the restoration can be equally well effected as follows :—Make the core of wet clay, or, better, of beeswax, then paste over it thin tough paper. Cover this with gum-arabic solution, and set the pieces on it. When dry, melt out the wax or clay.

Fish-gum, *colle de poisson*—that is to say, what is generally called *sturgeon's bladder*, which includes the bladder of several kinds of fishes dissolved—is best for glass, marble, porcelain, and all kinds of mending where the cement should not show. This, when combined with oil, is *said*, if mixed with cloth-dust and fibre of wool or silk or cotton, to spin up into thread.

MENDING GLASS

WITH SEVERAL ALLIED PROCESSES

APPROVED CEMENTS—SILICATE OF SODA

" Glück und Glas
Wie bald bricht dass."

" Good luck, like glass,
Soon breaks, alas!
Yet skill can bring it so to pass
As to mend a fortune or a glass."
—Old German Proverb.

Putty is naturally the first cement which suggests itself in connection with the mending of glass, since this latter material is most familiar to the world in the form of windows, although in many places—as, for instance, Florence, where it is called *mastico* and *pasta*—it is little used or known. The word is from the French *potée*, which also means a potful. It is very useful, not only for setting glass-panes, but for filling holes in wood, and forms a part of certain mixtures as a cement for moulding ornaments. It may be weak and brittle, or else strong and very hard, according to the manner in which it is prepared. It is commonly made by combining chalk in paste, with water, with linseed-oil ; other powders are also used.

In America it is made with pulverised soap-stone and oil. Its excellence depends on the quality of the oil and the care with which it is kneaded. It should be kept in a damp cellar, in wet cloth or under water. Should it dry and become brittle, fresh oil must be added.

"*To take hard old putty from glass window-panes*, cover it with a mixture of one part of calcined lime, two of soda, and two of water" (LEHNER). Oxide of lead combined with oil makes an excellent but yellow putty. It sets very hard.

The white or grey oxide of zinc combined with linseed-oil or linseed-oil varnish makes a cement which is used for making glass adhere to wood or metal.

Thick lacquers, such as copal or amber, may be used instead of common varnish with better effect, and the composition is better when calcined lime or oxide of lead are added. The excellence of the cement depends on the degree to which the ingredients are amalgamated or rubbed in together; and this rule holds good for all similar mixtures.

Varnish, or heavy or "flat" lacquer of copal or amber, forms of itself a strong adhesive, with the only drawback that it takes a long time to dry.

A VERY GOOD CEMENT FOR GLASS (LEHNER) is as follows:

Gutta-percha	100
Black pitch (asphalt) . . .	100
Oil of turpentine	15

This is a glue of general application, and specially good for leather and mending shoes.

The reader who would thoroughly study the subject

of glass may consult *Die Glas-Fabrikation*, a very admirable work by Raimund Gerner, glass manufacturer ; A. Hartleben, Vienna and Leipzig, price 4s. 6d.

Small triangles of sheet tin or iron are often used to fasten panes.

The mending of broken glass is in most cases much the same as that of broken crockery or porcelain. The cement made from mastic, or mastic combined with sturgeon's bladder, or generally of silicate with whiting, is the proper adhesive. As silicate of soda is simply liquid glass, it can be employed to fill spaces or to make glass ; but, owing to its sticky nature, it is hard to manage. This may be often effected by first preparing a layer of soft paper, on which successive coats of silicate are laid. When dry the paper can be washed away.

Silicate of Soda has become of such importance that a French work on mending fictile ware is almost entirely limited to its use as a binder, when combined with whiting. *Water-glass* was long supposed to be a modern invention, till some one found it described in Van Helmont's works, A.D. 1610. But I have found it also in the *Joco-seriorum Naturæ*, 1545 ; in the *Magia Naturalis* of Wolfgang Hildebrand, which is of the same time ; and, finally, by *Paracelsus* (*Liber de Præparationibus*), where he describes it as *Destillatio Crystalli.* And the author of the *Joco-seriorum* speaks of soft glass as a thing which had been treated by several writers.

According to Wagner there are three kinds of soluble glass—(i.) the soluble potash glass, 45 silex, 3 charcoal, 34 carb. potass.; (ii.) soluble soda glass, 100 pts. quartz, 60 cal. sulp. soda, 15 of charcoal ;

(iii.) double soluble glass, 100 quartz, 22 cal. soda, 28 carb. potass., 6 wood-coal. Water-glass combines well with any "indifferent" powder, such as powdered glass, to make a strong cement. To powder glass, heat it red-hot, drop it into cold water and pulverise it. It will become as fine as flour, and in this state combines with gum-arabic, or glue, or gums to make a powerful glass-mender. Mixed with powdered glass, oxide of zinc, or whiting, powdered marble, calcined bone, plaster of Paris, wood-ashes, &c., it can be worked like putty. Mixed with colours it is used for stereochrome painting, a kind of fresco.

Missing pieces of glass, such as leaves from a chandelier, can be easily replaced with water-glass, and all cracks or defects glazed over with it.

This mending is allied, however, to certain processes in art which are so interesting that I venture on a description of them.

A great deal of mending and restoring in glass can be effected by means of the blow-pipe and spirit-lamp or gas-flame. Difficult as this may sound, it is not only an easy, but also a very curious and entertaining, occupation. In any city an expert or workman may be found who would give a few lessons. I have very often been impressed with the fact that so little artistic invention or originality is found in glass-work. Even the far-famed Venetian work is extremely limited, and "mannered" or conventional, compared to what it might be.

The following is an old recipe for repairing glass: —Take finest powdered glass, best mastic, with equal parts of white resin and distilled turpentine. Melt

all well together. To use, gradually warm it and then apply.

Quicklime and white of egg, intimately rubbed into one another on a flat surface, make a good cement for ordinary glass or pottery.

The cement of *gum-arabic* is much stronger when made as follows :—Take gum-arabic and dissolve it in acetic acid (vinegar) instead of water. It must be melted in a hottish place, as it will in that case be much better. The finest quality of sheet-gelatine makes a transparent glue, invaluable where colour is to be avoided.

To mend a cracked Glass Bottle or Decanter. —Heat the bottle, pressing in the cork, till the hot air within expands the cracks, which must be at once filled with the liquid glass. Then, as the water-glass is driven in by the pressure of the outer air, as the bottle cools the cracks are closed.

You cannot well mend a broken looking-glass, but something can be done with the large pieces. Varnish or paste a piece of paper and lay it on the quicksilver. Then with an American glass-cutter, price one shilling, or a diamond-cutter, divide them into squares for small mirrors. Two of these of equal size can easily be converted into a folding kaleidoscope (not described by Brewster in his work on the Kaleidoscope). Lay the two pieces face to face, and paste over the whole, on the quicksilvered side, a piece of thin leather or muslin. When dry, with a penknife, cut a slit down between the two on three sides. It will then open and shut like a portfolio. This may serve as a travelling, looking or shaving glass, but it is very useful to designers of patterns.

Place the glass upright on a table at a right angle, or more or less, and lay between the mirrors any object or a pattern, and you will see it multiplied from three to twelve times, according to the angle. Beautiful variations of designs can thus be made, *ad infinitum*. They may be used as reflectors, when placed behind a light.

Take such a piece of looking-glass and lay a piece of paper on the back, and then with an agate or ivory point write or draw on it, but not as hard as to break the silvering. Then turn it to the sun or a strong light, and let the reflection fall on a white surface. Though nothing be perceptible on the face of the mirror, the writing will appear in the reflection.

Glass is engraved as metal is etched ; with this exception, that, instead of sulphuric or nitric acids, fluoric acid is used. Both glass and *china* can also be directly etched with a steel point, aided by emery powder ; which latter art I have never seen described, but which I have successfully practised. It is fully set forth in my forthcoming work on " One Hundred Arts."

Malleable glass, or at least that which does not break easily when let fall, is prepared by dipping the objects made from it, while quite hot, into oil. I conjecture that panes of window-glass thus prepared would not be broken by hail, as I have observed that plate-glass is not.

It sometimes happens that goblets of thin glass—especially those which have had a peculiar kind of annealing or tempering—ring beautifully when blown on so as to vibrate them. The effect is almost magical on one who hears it for the first time. I mention

it that the reader may, when he finds old Venetian or any other thin glass goblets for sale, see if there be not among them a finely ringing one. An organ could be thus made to play by wind. With regard to music on glass, take any ordinary bottle, and by rubbing on it a cork a little wetted you can, with a little practice, produce a startling imitation of the chirping, and even warbling, of birds. I knew one who could thus imitate to perfection nightingales and call forth responsive songs. The effect depends in a degree on the quality of the cork, and also that of the glass. With a violin-bow very musical sounds may be drawn from the edge of a pane of glass. It seems as if these methods might also be developed into musical instruments. It is well known that tubes of glass suspended when a candle is placed beneath them give forth musical sounds, often of great richness and strength. There are also the musical glasses, which may be played in two ways, either by rubbing the edges with a wetted finger or by filling the glasses more or less with water till an octave is formed, and then tapping them with a stick of wood. All of which has, indeed, nothing to do with mending glass, yet which may not be without interest to those who wish to learn all its qualities.

Among Glass Cements in common use which can be recommended are the well-known Polytechnic, also the Imperial Liquid Glue (no heating required), Hayden & Co., Warwick Square, London. There is also a very good glass cement made and sold by Keye, filter-maker, Hill Street, Birmingham.

The Venetians made ordinary glass goblets very beautiful by painting on them in relief with a sub-

stance which I suspect was in some cases a form of silicate, or else with a kind of paint which was not enamel, yet which seems to have been partly vitreous. It rather resembles oil paint with glass powder, but I doubt if it was this.

Working in glass implies the mending and restoration of stained-glass windows ; that is, of painting on glass and a study of designs. Of all this there is almost a literature. Among other works I can commend *A Book of Ornamental Glazing Quarries*, by A. W. Franks, £1, 1s.; *Divers Works of Early Masters in Ecclesiastical Decoration*, by Owen Jones, £3, 10s.; *Westlake's History of Stained Glass*, vol. i., *Fourteenth Century*, 13s. 6d.; vol. iii., *Fifteenth Century*, 18s., published by Batsford, 52 High Holborn. At Rimmel's, in Oxford Street, the reader can generally obtain these, and all works on similar subjects at prices much below the original cost.

A MENDING CEMENT FOR GLASS is made as follows :—

Common cheese	100
Water	50
Slacked lime	20

This is found in many books of recipes. It must be observed that the cheese is to be for some time carefully pounded with the water till quite soft, and the lime then very quickly stirred in. This is not only useful to mend glass, but can be applied to many other purposes. The cheese is best when fresh.

CASEINE (or pure cheese) can be combined with ease with liquid silicate of soda (LEHNER), and thus forms a very strong cement for porcelain or glass, or

any other material. Fill a flask with one-fourth of fresh caseine to three-fourths of silicate, and shake it thoroughly and frequently.

Another formula is as follows :—

Caseine	10
Silicate of soda	60

This must be used very promptly, and the article mended dried in the air.

A CEMENT which may be used in several combinations is made by dissolving fresh acidulated caseine (made by adding vinegar to milk, and carefully washing the deposit) in a very little caustic lye. It must be kept corked in bottles.

These *caseine* or cheese or curd cements hold well, but do not well resist water, except in powerful combination.

The excellence of cements depends to a great degree on the quality of the materials and the scrupulous observance of care in making. Thus for the following, for glass :—

Glue	200
Water	100
Calcined lime	50

in which we have one of the commonest and oldest formulas, the value depends on " the make-up ;" that is, the glue must be left in cold water for two days, then boiled in a *balneum mariæ*, or a double kettle, in lukewarm water ; that is, it must not boil, or the glue will be weakened.

The so-called DIAMOND or TURKISH CEMENT, for

glass or any other fine work, has been known since early times as incredibly strong. Its formula, according to LEHNER, is as follows :—

I.	Sturgeon's bladder . . .	20
	Water	140
	Spirits of wine . . .	60
II.	Gum-mastic	10
	Alcohol	80
III.	Gum-ammoniac . . .	6

These are three separate portions, No. I. being prepared by warming and filtering. The gum-ammoniac is reserved from the others, and added *after* they are mingled.

A STRONG BASE FOR A CEMENT FOR GLASS, as well as wood or stone, is made by gradually stirring finely sifted wood-ashes into silicate of soda, or strong acid glue, till a syrup-like substance results. In America the best ashes for this purpose are those of the hickory. Perhaps beech wood yields them equally good.

There is a DIAMOND CEMENT which is of special value to attach gems to rings or metal, to make coral or pearl or ivory adhere together, and, in short, for all fine work where a very strong adhesive is required. It is as follows :—

Sturgeon's bladder	8
Gum-ammoniac	1
Galbanum	1
Spirits of wine	4

The sturgeon's bladder is cut into small pieces and steeped in the spirits, and the rest, in solution, then added. It must be warmed again when used.

As this cement will bear long exposure to moisture before being at all injured by it, it can be used as a medium for painting on glass, and thereby producing effects very little inferior, either as regards beauty or durability, to glass itself. The experiment can be easily tried, as any chemist can make up the recipe. When finished, the painting can be coated with liquid silicate of soda, which will give it all the property of glass.

A LIME CEMENT FOR GLASS is made as follows :—

Calcined lime	30
Litharge	30
Linseed-oil varnish	5

JEWELLERS' CEMENT. Extremely strong :—

Fish-glue solution	100
Mastic varnish (pure) . . .	50

The fish-glue must first be dissolved in spirits of wine.

TO JOIN GLASS AND METAL, &c.—Stir slacked and powdered lime in hot glue. This sets as a very hard substance. It can be extensively modified and varied for many substances, and used for painting.

CEMENT FOR GLASS :—

Gum-arabic	50
Sugar	10
Water	50
Oil of turpentine	10

The gum, sugar, and water are first carefully combined, and then the turpentine well stirred with the mixture.

SALLE'S CEMENT FOR GLASS :—

Muriate of lime	2
Gum-arabic	20
Water	25

Not commended by LEHNER, as being too soluble.

TO CLOSE BOTTLES :—

Powdered resin	6
Caustic soda	2
Water	10

To be thoroughly mixed and left for several hours. Before using, stir well into it eight to nine parts of calcined plaster of Paris. This will in half-an-hour take firm hold or "set," and is waterproof. A good filler for cracks.

The reader who desires to be perfectly informed as to glass in all its relations can obtain, by application to J. BAER, Rossmarkt, Frankfort on the Main, Germany, a catalogue which is perhaps the most extensive on the subject ever published.

Coloured or stained glass windows may be repaired or made by the following process, which has the advantage of being quite as durable as any in which the colours are burned in :—Take two panes of glass, and paint on one your pattern with fine varnish and transparent colour mixed. When dry, go over the whole, with a broad, soft brush, with a liquid mastic cement, which must be quite transparent and thin. Any transparent strong cement will serve, but it is advisable to use the mastic in all cases as a narrow border and at the edges. If you have an engraving, especially one on very soft spongy paper, take a pane of

glass, cover it with a coat of varnish, and just before it dries press the engraving face down, on it. When quite dry, with a sponge slightly damped and the end of the finger, peel away all the soft paper, leaving the lines of the engraving. These may now be coloured over, with even very little skill and care. A very good effect may be produced, so that a very indifferent artist can in this way produce very tolerable pictures. Then, to better preserve this, double it with the other pane.

By painting and shading also on this *second* pane, as I have discovered, very beautiful and striking effects of light and shade can be developed, so that this forms, as it were, a new art by itself. This will remind the reader of the porcelain lamp-shades, which so much resemble pictures in Indian ink ; but the effects of the double panes are more singular and far more varied. There may be even a third pane employed. As the materials for this art are far from expensive, and as it is extremely easy, I have no doubt that it will be extensively practised. Protecting one glass picture by another is not a new art ; but I am not aware that the obtaining a series of lights by thus reduplicating the panes has been practised.

A modification of it is as follows :—Cut out several panes, corresponding to the size of the two glass covers, of quite transparent paper or parchment, prepared by rubbing with oil or vaseline, lard, or the like. Paint on these the required modifications of the picture. The advantage of this is, that a great many shades can thus be given in a thinner space, creating an astonishing effect. As this is not at all a mere imitation of stained glass, and as it produces

effects not to be found in the latter, it may rank as an art by itself. The chief of these effects is *relief*, especially shown in the human figure. But the most extraordinary are the variations of chiaroscuro which it affords, by availing himself of which the artist may create or obtain striking suggestions for oil or *aquarelle* pictures ; for these transparencies can be so infinitely and ingeniously varied that no one can fail to derive from them many ideas.

This may be tested by simply preparing any picture, say of a statue, a castle on a rock, or a face. Cut out from sheets of the same size in very transparent paper a series of shadows adapted to it, and adjust them. They may be all in monochrome or one colour, or in many hues. They may range, with proper care, from almost imperceptible shadow to opaque black. By beginning with only two stencils or shaded pictures—for as regards these the artist must be guided by his own skill—and gradually increasing the number, the proper adjustment will soon be found. I advise the beginner in copying to proceed from monochrome to two colours before attempting many. Teachers in *aquarelle* will find that such copies are—after a certain degree of proficiency shall have been obtained—much superior to those commonly used, as they come nearer to nature.

The most perfect form of this curious art is an improvement which, I believe, is my own invention. This consists of introducing leaves of painted *mica* between the two glasses. In this way four grades or tones of colour and light and shade can be made in a picture. Mica-leaves can be made into one by using

mastic cement. Rub the edges with emery-paper to roughen them.

As I have already intimated, the materials for this work are so cheap and the process so easy, that all which I here assert may be at once verified by the outlay of a few shillings, with a few hours of time. It is, in another form, the same thing as arranging lights around a statue in a dark room, but adapted to all kinds of pictures.

As a Latin poet has declared, "It is an easy thing to add to arts," when a beginning has once been made ("*Inventis facile semper aliquid addere*"), so I will add to this a curious discovery in glass made by me in Venice a few years ago. I was being taken by Sir Austin Layard over his celebrated glass-factory. It was he who, with the aid of Sir William Drake, *first* revived the almost forgotten manufacture of glass in Murano. While standing with him by a furnace watching a workman skilfully forming ornaments in glass, it suddenly occurred to me that the Chinese were said to have possessed in remote times an art, now lost, of making vases or bottles which appeared externally to be quite plain, but on the surface of which, when red wine was poured in, patterns or inscriptions appeared of the same colour. It at once occurred to me that this could be perfectly effected by making a bottle, on the interior of which the ground should be of considerable thickness, say half-an-inch, while the inscription or pattern would be no thicker than ordinary window-glass. Then if the whole exterior were to be lightly ground on a wheel or sand-papered, the difference between ground and pattern would not be perceptible until red wine or some

highly coloured fluid were poured in, when the pattern would at once show itself.

Sir Austin Layard was so much struck by the suggestion that he sent at once for his foreman, Signore Castellani, who said that he had heard of such bottles, but always supposed it was a fable. He, however, at once admitted that they could be made as I proposed, but added that the expense would be so great as to render the invention practically useless.

It has, however, since occurred to me that such bottles could be made, and cheaply, as follows :— Take a Florence flask, and divide it into two parts with a diamond, using a saw for the bottom. Then on the sides within place the ground. It could be made of silicate of soda and powdered glass or flint, or even of white wax, hardened with powdered glass. Close the bottle with silicate, and grind the whole.

When any glass has been broken and mended, the fracture still discernible may be thus concealed by grinding the surface, and in many cases by surrounding it with a ring or tube of metal, also by one of silicate, or with an ornament formed with it.

A glass stopper when too large can be easily filed down to fit. Should the neck of the bottle be too narrow, it can also be enlarged by the same process. When the rim of a goblet is fractured, it can be ground down on a grindstone. I have done it with a file.

A pane of glass can be somewhat rudely cut into shape with a pair of strong scissors, under water. In this, as in other things, practice leads to perfection.

An old method of effectually closing bottles of wine was as follows :—The edge of the opening on the top was ground down on a stone, and a small disc of

glass was exactly fitted to it. Heat was then applied till both were in partial fusion and the cover was welded to the bottle. A little powdered glass would aid the fusion, or it could be effected with silicate without heating. The process is the same as using glass stoppers, rather sunk in, and sealing up with silicate.

A broken champagne bottle is not easily mended, but I have seen one curiously utilised. The bottom only had been broken, and it was cut off round and evenly with a file. Within it there hung from the cork by a cord a very large nail or small bolt of iron. Thus prepared, it made a capital and appropriate dinner-bell. Here in Italy I have often seen bells made of crockery or terra-cotta ; their tone is better than would be supposed.

WOOD-SHAVINGS

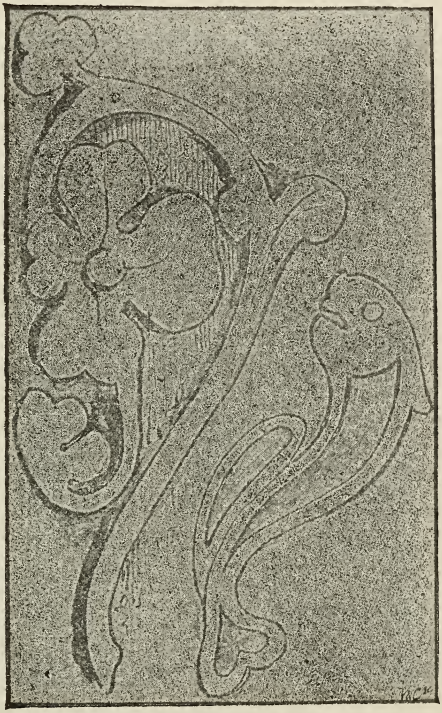
IN MENDING AND MAKING MANY OBJECTS

> "*In human industry there is on an average a loss of fifty per cent. in labour or material.*"—Observations on Art, by CHARLES G. LELAND.

THERE is no country in the world in which the art of mending is so much required as in the United States of North America. The reason for this is the extraordinary and sudden changes in temperature, causing the expansion and contraction of cells and fibre, especially in wood, which results in cracks. Thus seasoned furniture and carvings, which have remained unchanged for centuries, it may be for a thousand years, in any part of Europe, shrink and split very often within a month after being placed in a drawing or dining room in Boston or Philadelphia, as I know by sad experience. Thus I have known a very beautiful Italian mandoline, three hundred years old, richly inlaid with ivory, to so shrink and warp in America that a professional mender declared that nothing could be done with it. The sounding-board had curled up like a scroll and split, and the mosaic or inlaying had fallen out in bits.

In such a case, carefully detach the warped piece or pieces, and dampen the concave side carefully with a

sponge till it resumes its flatness or usual form. When this is attained, take very thin shavings of a firm wood, as thin as they can be shaved, and glue them transversely, or *grain across grain*, to the under or plain side of the board. This will probably prevent all warping in future, especially if the best mastic and fish-glue is employed. It may here be noted that where the shavings cannot be obtained, thin parchment or even note-paper may be used, and that good, strong varnish, or not too thin, may be used for a binder. There are many cases in which parchment or paper are preferable to wood in repairing, as being less liable to warp or crack.



Patterns cut from Wood-Shavings.

Wood-shavings, which are as yet but little utilised in art, have, however, before them "a great future." Combined with glue, or other binders, they can be made, even under the hand-roller, into boards, which have the advantage that they can be moulded, curved,

or turned to suit many emergencies which would require a great deal of saw or carving work.

It is not unusual to employ veneers, or very thin sheets of wood, as a guard across the grain where shrinking is to be apprehended, as in tablets for painting on or panels, and it is a great pity that this very cheap precaution is so little used. But there are very few cases in which shavings are not as applicable, and they have the great advantage of being obtainable wherever there is a plane and wood.

Holes or defects in wood—for example, in American shingle roofs or the clap-boarded sides of houses—can often be more cheaply and readily repaired with shavings and glue (into which oil is infused) than by any other means. And it may be observed that such a coating of shavings and glue, laid on to a new roof, is the cheapest and most effective protector against rain or sun or frost.

In certain work wood-shavings can be advantageously combined with paper to give a solid, smooth surface and firm body. Here the paper-paste, with or without sawdust, is first forced into the cavities, and the shavings superadded.

Shavings and glue are excellent for the temporary repair of boats, and if the mending be *properly executed*, it will be as durable as the original wood. It would be an easy matter indeed to make a canoe entirely of shavings and glue. If the hand-roller be well used and thoroughly applied, the result will be a very firm fabric.

It may be worth knowing in the wilderness, that where a backwoodsman has a *plane* (and he can always make one if he has a chisel, which, again, can be

made out of a knife-blade) he can make shavings, and with these and some kind of *binder* —even clay— he can lay a dry, hard floor, when perhaps boards are not to be obtained. The substratum may be of beaten clay or stone. If of sufficient thickness and well rolled, such a floor as this would be impervious to damp.

Any surface can be very well *veneered* with shavings and glue. Smooth the surface by pressure or rolling, and when dry glass-paper it. Ve-

Pattern to be cut out of Shavings and applied with Glue to a Panel.

neers are often not to be had ; shavings may be got in every carpenter's shop.

Not only very strong and elastic canes, but even *bows* of a superior quality, can be made of shavings. The Indians in Pacific America make the latter by pasting and pressing one shaving on another with great care. It may be understood that where the grain, as in a piece of wood, runs *altogether* in one way, it will split with the grain. But where it is not uniform or connected, and is very powerfully incorporated by pressure with a good binder, we may easily have a very elastic and tough fabric, not so likely to split as wood. Thus we can make from hickory shavings a wood less liable to warp or split than the original wood itself.

Wood-shavings and glue are admirably adapted to repair broken boxes or any other articles of wood, especially for smoothing over roughly mended surfaces and covering knot-holes or other defects. In all cases when possible use the roller, and when pasting one piece on the other cross the grains.

Musical instruments, such as guitars, violins, and mandolins, are very easily repaired with shavings and glue ; and this is, indeed, in many cases, the very best means of reparation, since, while a piece of wood may or may not injure the tone, the shavings always give a good vibration. And where it is quite beyond the power of any ordinary amateur, say a lady, to set in a piece of wood or apply one, or to get it of a proper thickness, anybody with care can paste on thin shavings—the thinner the better—till the defect is repaired. In many cases parchment or paper will answer just as well, and I have myself thus perfectly mend-

ed violins which were apparently beyond all bettering, and got to the stage of *lasciate ogni speranza*, or hopelessness.

There are, however, many cases of badly fractured objects in which the owner gives up hope, because it seems *impossible to make a beginning*. Now, "whatever can be made can be mended" is true of everything except morals, and even in these there is more to be done than men wot of. And in a great number of these cases parchment strips, thin linen tape, or especially wood-shavings, can be used with success. Bring the broken edges together if they warp apart, and attach them with the strip and strongest cement; that is, with small pieces of the "fastener." Do not attempt to do everything at once. When the edges are united and the *binder* dried, fill in all crevices or holes with a suitable paste or "filler"—not too much at once, in certain cases. Then, as will generally be required, cover the surface with thin shavings and binder; as it dries, file or glass-paper it smooth. The shavings will make, with mastic and fish-glue, in many cases, a far better repair than could be effected with a piece of wood or parchment, because they will never *split*, like the former, if they are applied lying transversely or crossways, nor stretch like the latter.

It may depend, in many cases, on what *wood* the shavings consist of. As I have observed, even in the bush a plane can be made with a chisel or a piece of a table-knife blade, set in a wooden block; but elsewhere any carpenter will easily supply what is wanted, *ad libitum*.

The paste or filler of wood-powder or paper-pulp will be found described in other chapters.

ORNAMENTAL WORK OF SHAVINGS—MARQUETRY

A curious kind of ornament can be made by cutting out decorative patterns, human figures, animals, flowers, &c., from shavings with scissors or penknives, then glueing them on a smooth soft board. Apply as much pressure as possible, so as to make them sink into the wood, and when dry coat the whole with varnish, till an even surface is established. Rub over the dried surface with finest glass or emery-paper, and then smooth patiently with the palm of the hand. If this be well executed the result will be a perfect imitation of inlaid wood, although it is really an art by itself, which, I believe, is my own invention. Thin veneers may also be used instead of shavings. Ebony or walnut thus *appliqué* on *larch* or *holly* make exquisite work.

This kind of ornament has great advantage over inlaid wood or marquetry, for the pieces of which it consist are far less liable to be detached or peel off, while it looks quite as beautiful. And be it observed that, laid with a transverse grain, it prevents warping and strengthens the ground, while inlaying weakens it; for to make the bed for inlaying or mosaic we must excavate the bed till it is extremely thin and liable to warp, whereas in shaving-work we make a light but very strengthening addition.

A single experiment will suffice to convince the reader of the merits of this very useful, elegant, and novel art. It is specially applicable to ornamenting albums and book-covers, where it may be used even on pasteboard.

REPAIRING PANEL PICTURES WITH SHAVINGS

It is often a very difficult matter to obtain a thin panel or strips and do all the work properly when we wish to put into shape a warped panel, let us say of an old picture, which is on the point of splitting. The inserting screws is very dangerous. I myself have inadvertently thus made a fearful blemish in a Madonna's face. But if we use *shavings* there is no such danger. Wet the back till the panel is flat, and then *gradually* glue on the shavings across the grain. This is as well done with small bits as large. With a picture it would be well to continue the coating to the thickness of one-third of an inch or more, but a very thin coating will go far to prevent warping or bending. The thinnest panels or veneers may be thus "backed up" into solid boards. In all cases where practicable, use heavy pressure on the roller.

REPAIRING WOODWORK

"*Among the thousand mad schemes which were proposed by projectors was one for making sawdust into boards.*"—History of the South Sea Bubble.

VERY few people, even among workmen and artists, are aware of what remarkable and curious restoration the most decayed pieces of wood are capable. We will, however, begin with the simplest repairing, or that of furniture.

When articles of furniture have been strongly and properly made of oak or other hard wood, and as properly used, they will last for centuries; and should some unforeseen accident take away legs or arms, they can be perfectly replaced, especially in the admirable old-fashioned German objects of the kind, which were all put together with wooden pins or by means of mortise and tenon, so that, when need required, they could be packed as boards;—nor were they the less elegant for this. But if furniture be simply sawed from soft, cheap deal or poplar, and merely glued together (as most cheap furniture made in England is), it will soon warp and break up, and all the mending in the world will not make it better than it was when new. Glue is, therefore, the great mate-

rial for most woodwork, and, as I shall show, in two very different forms.

Having a broken chair-leg, which can, however, be fitted together, first prepare your glue in a proper kettle—that is, a *balneum mariæ*, or one kettle in another. In the outer is only boiling water ; in the inner the glue, mixed with water. The reason for this is, that glue, when softened with water, dries up very rapidly under the action of air or fire, while the softer heat of water keeps it, so to speak, "alive."

But if, while the glue is soft, we pour, say, a teaspoonful of nitric acid into half-a-pint of glue, it will remain soft a much longer time—which is a valuable secret to many, especially where large, broad surfaces of veneers are to be glued on, and where, the process being slow, it is desirable for the adhesive to remain soft for many minutes. And here I would mention that the acid-glue will remain in a liquid state for one year if tightly corked up in a bottle. Its only defect is a disagreeable, pungent smell.

This glue can be improved by being made as follows :—Take of best glue three parts, place them in eight parts of water, and allow the mixture to soak some hours. Take half a part of hydrochloric or muriatic acid and three-quarters of a part of sulphate of zinc ; add to these the glue, and keep the whole at a moderately high temperature till fluid—that is to say, boil the glue as usual in a *balneum mariæ* or in hot water, after soaking it all night in water. Then stir in the hydrochloric (or muriatic) acid and sulphate of zinc. This is a first-class glue. Keep it in a bottle with an oiled cork ; any other stopper would adhere. But for all ordinary work the glue, with

nitric acid, will suffice, as it holds with great tenacity to anything.

This glue, which keeps liquid for a long time, and which holds without scaling off, as common glue often does, may also be made with *very strong* vinegar. The latter, in fact, amounts to the same thing in most European countries, but especially in the United States, where, according to the New York *Tribune*, there is literally no vinegar sold or made, save from sulphuric acid and water. Perhaps when mankind shall have reached a higher stage of civilisation, all dealers will be compelled by law to place on every article of food sold the list of ingredients of which it is composed. We should then know how much oleomargarine passes for butter, and what proportion of "delicious conserves" are manufactured from apples alone or turnips.

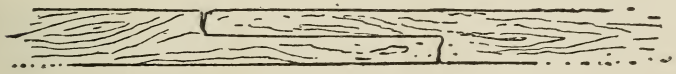
Observe that in glueing ordinary wood together the two pieces to be attached should be gradually but very well *heated* first. This renders them more inclined to "take" the glue. This is applicable to other substances.

Also note that when two surfaces have been made to adhere with ordinary water-glue, should they come apart when cold, it is very difficult to make them unite again. But this is not the case with acid-glue. And if you have such surfaces which will not unite, wash them with nitric acid or very strong vinegar, and the glue then applied will "take." Also observe that the acid-glue is far stronger than the common kind.

Having the broken leg fitted, first with a narrow gimlet or brad-awl make a hole crossing the fracture,

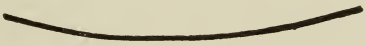
then glue the pieces together, and before the glue dries put a screw or two through the hole ; *i.e.*, *screw* the pieces together. This will hold perfectly, if you will sink the head of the screw in the wood, smooth it with a file, then putty it over and paint it.

It seems strange that anything can be so mended as to be stronger than before ; yet this is literally true as regards the broken leg of a chair, a cane, a beam, the mast or spar of a vessel, or any similar long piece of wood. This is effected as follows :—Cut the two separated pieces into two exactly fitting "steps" or mortises, as shown in this illustration.



Fasten these with glue and screws ; or, better still, by adding to both two sliding, tightly fitting ring-tubes, or one long one. This will actually make the stick stronger than it was at first. The rings should be covered with paper, glued, and then painted and varnished.

The processes of glueing and screwing are applicable to most fractures of furniture. Where a piece of wood is broken away, it, or a similar piece, must be inserted. When wood is warped it may be straightened by applying wet towels. Observe that if a flat panel is warped thus—



you must wet the upper or concave side, put it under heavy weight, and as soon as it becomes straight,

screw it down with transverse strips. Drawers which are made from badly seasoned wood are a grief to the heart. They warp and stick. When you find that such is the case you can save yourself much annoyance by examining them, planing away the obstructions, and nailing transverse strips of wood across ; that is to say, pieces in which *the grain* of the strip crosses that of the wood. Very good and well-seasoned English furniture often warps badly in India ; therefore it should be thus protected. This can in most cases be better done with strips of metal. In large wardrobes, presses, or chests, where there are broad and often thin panels, this precaution should always be taken. As I write I have just seen two exquisitely painted and valuable pictures on panel, one of which had curved and split in two, while the other was badly warped for want of such a precaution, which would have cost only a penny's worth of strip and screws and half-an-hour's work to save them.

It will very often happen in mending furniture that neither nail, glue, nor screw can be relied on. In such case bore with a suitable gimlet and pass wire through the hole. Flexible wire twisted in two strands, with the ends properly secured, say to the head of a screw, all being sunk beneath the level, will hold almost anything.

Frames for looking-glasses or pictures often "spring" at the joints. In such cases a screw with acidulated glue will make them permanently strong.

Always put handles to drawers. The vile invention or device of using the key for a handle is by far too common. Metallic handles of brass are preferable to wooden knobs. Keys are often lost, or else break.

The bottom of a drawer should always be secured by screws.

When the bottom of a drawer, as frequently happens, shrinks and becomes too short, so that there is a long opening, the latter should be filled with a strip of wood. The chief cause why modern furniture is apt to become loose or separate is chiefly due to its being made either of unseasoned or soft wood, such as weak deal or poplar, which absorbs moisture from the air and then dries and shrinks, or because it is made of too many pieces only glued together, and that with cheap, bad glue.

Restoring Decayed Wood.—The worst cases of decay or of worm-eaten wood can be perfectly restored in this manner:—Take fine sawdust of the same kind of wood as the original. Let it be as fine as possible, either cut with a refined saw or powdered in a mortar. Sift it. Then with acidulated glue, or else plain, clear, white Salisbury glue for light wood, make a paste, well mixed. With this you can fill up holes (using a spatula or flexible knife or ivory paper-knife). But, what is more, you can thus make a very strong *artificial wood* which can be moulded into any form, and when dry polished by cutting over the surface with a chisel or flat gouge, and using a file or glass-paper to finish. In fact, you can mould or model figures with this wood-paste by itself. Putty is generally used for such repairs, but the wood-paste is like wood, and quite as durable.

If you have a mould of plaster of Paris, boil it in oil, clean it, and then oil it. With the wood-paste you can make ornaments which can be applied to plain wood surfaces.

Splints, fractures, cracks, holes, corners broken away, are all easily restored with wood-paste. In moulding it the fingers should be oiled to prevent its sticking.

Any kind of dry sawdust can thus be converted into a paste, which, when dry, becomes wood. It may be very much hardened under a hydraulic-press or by a wooden hand-roller. Housekeepers should use this composition for filling up rat-holes, or any kind of crevices in furniture, or panels, or doors and walls, especially where such cracks harbour insects.

It would be perfectly possible to construct an entire house of such wood-cement, and one which would be perfectly durable, or even more so than wood, since beams and planks thus made never crack, split, nor warp. With it the boldest vaulting and arch work can be more easily made than in stone or with wood, as the latter is usually worked. As builders in Turkey form domes by making circles of clay or mud, and gradually add to the first a smaller one, so by using wood-paste the largest space could be covered or domed over without building a scaffolding. There are many places in the world where (as in the prairies of America, Russia, and Hungary) large timber is wanting, but where small wood for sawdust is more available, and yet where, as cattle abound, glue would be very cheap. This material deserves more serious attention than it has ever received.

More than twenty years after I had invented, or at least projected and put in practice, this method of making artificial wood, I found the following in the *Manuel Général du Modelage*, par F. Goupil ; Paris, Le Bailly :—

"To make vases, take fine dry sawdust and pass it through a sieve. It may be made into a paste with a compound of turpentine, resin, and wax. Or mix the adhesive with five parts of best strong white glue (*colle de Flandre*) to one part of fish-glue. Melt them separately, . . . pour them together, boil to a proper consistency, and mix with the sawdust. By this process figures can be cast which, when finished by hand, exactly resemble carved wood."

Another recipe is to take 750 grammes of strong glue to 1½ kilogramme of gall nuts. To be mixed cold. Mix in hot water with sawdust.

Since writing the foregoing I have found the following recipe in a MS. of 1780, a family heirloom kindly lent me by Miss Roma Lister :—

"*To cast Wood in Moulds as fine as Ivory, of a fragrant Smell, and in different Colours.*—Dry Lime Tree wood sawdust in a pan by a gentle fire, and beat it to a fine powder in a stone mortar. Sift it through Cambric, and keep it in a dry place free from dust. Then add to an equal quantity of Gum Tragacanth and Gum Arabic 4 times the quantity of Parchment Glue. Boil them in Pump Water, and filter through Linen. Stir into it the Wood powder till it becomes of the substance of a thick pastry; stir it all together, and set it in a glazed pan in hot sand, for the moisture to evaporate till it be fit for casting. Mix your colours with the Paste, and to give it a Scent put Oil of Cloves or Roses or the like, which, if you please, you may mix with powdered Amber. Anoint the mould with Oil of Almonds, and put your paste into it. Let it dry for 4 or 5 days, then take off your mould, and the Images will be as hard as Ivory. You may cut, turn, carve, and plane this wood, and it will have a fine scent. The mould may be Plaster of Paris, but it were better made of metal."

I would add to this, that where heavy pressure or nand-rolling can be applied this becomes really hard. Also note that any light, dry wood of fine texture can be dried and powdered for this purpose. The paste, even with common fine glue, can be used for very fine repairing. By sifting and pulverising, the dust may be made as fine as flour. A little calcined and powdered glass adds to its strength.

To make *panels* for furniture, walls, or boxes, take firstly a thin panel of seasoned wood, fasten two strips of sheet-tin across the back to prevent warping, and make or apply the cast to this. Very beautiful work can thus be produced very cheaply.

It may be here observed that this principle of mixing a powdered substance with glue or gum or an adhesive runs through all the arts of mending. The powder of cocoa-nut shells, slate, of paper, plaster of Paris, of leather, clay, lime, fine sand, and many other substances, can all be combined with adhesives, acids, or chemical solvents in such a manner as to form what may be called generically *cements*, or substances, or *pastes*, which become hard. Any glue or gum, or liquid which will make two surfaces adhere, can be mixed with most organic or inorganic hard substances in powder so as to form a paste which, when dry, forms a solid, hard substance, because the grains of the powder are thereby cemented together. Most of these yield to the action of water, but there are a few which resist both water and fire, all of which will be described in this work.

Broken ebony can be filled in cracks with a very neat and dainty paste or cement made as follows :— Take dried rose-leaves, or any others as soft, steep

them in just enough water to soften them, add of gum-tragacanth and gum-arabic just enough to make a paste, and sufficient ivory black to give it an ebony colour. Macerate the whole in a mortar. In the East a few drops of otto of roses or of geranium are added. From this heads are made, also medallions, or any other small objects. The composition sets very hard, and much resembles ebony. I have made many small objects of it myself, and can testify to its excellence. It is in this manner that the black rosaries from Constantinople are made.

A very good cement for filling cracks in furniture or other woodwork is made as follows :—One part of finely powdered resin and two parts of yellow wax are melted together, and to this is added two parts of finely pulverised ochre, or other suitable colouring earthy substance. This is an excellent cement in all respects, except that it yields to great heat. For all such repairing sawdust and glue is much to be preferred.

In repairing furniture, remember the screws hold much more firmly if they are just dipped in boiling beeswax or turpentine. If you are not accustomed to screwing or nailing, just make a hole with a bradawl, else you will find the screw or nail going out of the side of the box, or in some other undesired direction.

Clamps, or pieces of wood connected by screws, ties, or elastic bands, are indispensable in much glueing pieces together. They are, however, easily made. A good clamp can be made by bending over the two ends of a strong piece of wire. Hammer the ends into the wood.

Glue is more elastic when mixed with a little glycerine. This should be borne in mind when mixing glue with sawdust to form artificial wood, and, in fact, in many manufactures and combinations where it is specially desirous to have a certain degree of toughness or flexibility in the object made.

To utilise waste matter is allied to mending, which is only preventing waste. For this purpose common wood-shavings may be used for a pretty art. Take good shavings of any wood, and after moistening them with glue or gum tragacanth and arabic, press them flat. Trim them with scissors into leaves, or make them into flowers, and attach them together. Then pour over them liquid plaster of Paris, in which there is gum-arabic and alum dissolved. Take a bush, or plant without leaves, and gum the leaves to it or to its twigs. Cover bare places with the gypsum. When dry varnish the whole. A Professor Heigelin, in Stuttgart, once had an exhibition of such work. Frames can be decorated in this manner. Paint, gilding, and enamel, or bronze powders, can, of course, be applied. Shavings combined with weak glue submitted to pressure form artificial wood or boards, which can be improved by further combination with waste-paper. Made with a solution of alum it is fireproof. Its strength will be in proportion to the pressure applied. It can often be employed in repairing when suitable wood is wanting, and has the advantage that it can be turned to any shape.

The reader can easily satisfy himself by experiment that these artificial woods made from sawdust or shavings, combined with adhesives, are very easy to manufacture, very cheap, and, when properly made,

extremely strong. When strong pressure or rolling can be applied, the quantity of adhesive may be diminished. Linen or muslin rags, cotton-wool, or any textile fabric can be added to the shavings, as well as waste-paper of all kinds. Anything fibrous or stringy will aid in the binding.

This subject may be studied in detail in a work entitled *Die Verwerthung der Holtzabfälle*—The rendering valuable of Refuse-Wood, such as Shavings, Refuse Dye-Wood, &c., showing how they may be converted to Artificial Wood, Fuel, Chemicals, Explosives, &c.—by ERNST HUBBARD; Vienna, price 3 marks.

Wood of all kinds is in America sawed into such thin veneers that they are used to serve as wall-paper, being attached with paste. When damp they bend like paper. Such veneer is very useful for repairing wooden surfaces.

Common putty is not always to be trusted in for repairing wood. It sometimes shrinks, and is never very hard. The glue with glycerine and sawdust or cocoa-nut dust is preferable.

"Scratches and chance cuts may be remedied by merely melting or washing and rubbing in with cold water. But for most small defects a *filler* is used. This is a kind of paint or liquid cement, the object of which is to fill up the pores of certain coarse woods and make the surface fine. Soft wax, flour, and varnish are used for this purpose."

Any dealer in paints and varnishes will supply a filler for any special work.

Staining or colouring wood is an important part of repairing. "Oiling alone is a kind of colouring,

for all oiled wood becomes much darker in a short time."[1]

Soda dissolved in water gives to oak wood a much darker tone. Dark tea and alum is also useful, and still better very strong coffee. Also porter or beer mixed with umber. Also a decoction of walnut-leaves boiled down. In using these or any other colours the following rules must be strictly observed :—(1.) Use a sponge or brush, and do not apply the dye freely or pour it on, as you will run great risk of warping the wood or making it split. (2.) Exercise the greatest care in drying it near a fire. (3.) Do not expect to colour all at once by a profuse application. However light the colour may seem, always when it is dry rub off the colour with a rag or chamois-skin, and then make a second wash. This process will make the dye strike in deeper and last longer..

Stevens' Stains, also those of Mander, are very good and strong. They generally require dilution.

Ammonia is much used to give wood a dark rich colour. Wood thus treated, if afterwards exposed to the smoke of a wood fire, assumes a very ancient appearance. Bichromate of potash with water is a good dark dye, but it must be carefully handled, as it is very poisonous and injurious to clothing. It is used to give a waterproof quality to certain cements.

Good writing-ink is a very good black dye. When it is quite dry, oil, rub, and polish it, and the ink will resist a great deal of wetting.

It should be remembered that with ink, as with

[1] *Vide* "Wood-Carving," by Charles Godfrey Leland, F.R.L.S., M.A. (London, Whittaker & Co., 5s.), for a chapter on this subject.

dyes, there should always be at least two applications, and that the first should be very thoroughly dried, if possible, in a strong light, though not in sunshine, before the second is laid on. Three coats of blackest ink well dried in, then rubbed in well, and finally oiled, form an almost waterproof cover.

When panels of marquetry or of inlaid wood of different colours are broken away or require to be replaced, it can be done in the following manner :— Take a panel of very firm fine white wood—holly is the best ; next to it Swiss or German larch—draw on it your pattern, and then with a penknife go over all the pattern, cutting into the panel about a quarter of an inch, or rather less—in no case far enough to cut through. Then carefully fill all these lines with a firm cement, and let it dry well. Then with a dye —not with paint—color each piece appropriately. The cement and lines will prevent the dye from spreading from piece to piece. This is known as Venetian marquetry. When finished, apply *Soehnée* varnish, and rub down very carefully by hand. It is a very beautiful and easy work, not to be distinguished when well done from real inlaying. Very cheap and plain old furniture can be easily made very elegant by having panels, &c., of this work applied. The reader may begin with a small box or three-legged stool, working directly on the wood, and will then probably be encouraged to proceed. Dark brown patterns on light yellow wood look well.

This work is very easy and elegant, very little made, and may be therefore profitable. Any kind of light or white wood, such as deal or pine, may be used for common decoration. Cheap violins and

guitars are sometimes made into handsome ornaments for rooms by this process. For designs for this purpose consult the Manuals of Design, Wood-Carving, and Leather-Work, by the Author (Whittaker & Co., No. 2 White Hart Street, London, E.C.).

Marquetry may also be mended by making and colouring wood-paste, in which case prepare the ground with great care, by roughening, to hold the glue; also by using coloured cements, such as bread, well worked with powder and glycerine-glue.

It does not seem to occur to many people—even to those living in the country—that there is a great deal of strong, plain, useful furniture which can be easily made at home at no very great expense, boards of good quality being cheap enough. With a few lessons from an expert, or even with the study of a good elementary manual of cabinetmaking, any amateur can succeed. Whoever can make a good box can make an antique chair, and this can, however plain, be carved, stained, or marquetried into beauty; but let him beware of sawed curves.

Where there are worms in furniture or other wood, they should always be very promptly exterminated, else they will destroy it in time. To remove them, dissolve 2 drachms of corrosive sublimate in 2 oz. of methylated spirit and 2 oz. of water, to be applied freely with a feather or brush. This is an unfailing remedy; but the mixture is poisonous, and therefore should be kept labelled out of harm's way (*Work*, Sept. 1892).

In restoring or repairing woodwork we must have some knowledge not only of paints, varnishes, putties, and filling, but also of agents which prevent organic

change or are applicable to peculiar accidents. One of the principal of these is known as *knotting*. Its properties and general nature are freely explained in the following article from *The Decorator*, Sept. 1892 :—

"'Knotting,' or, as it is usually written, *Patent Knotting*, is a quick-drying, semi-transparent fluid. It is made from naphtha and shellac ; hence its quick-drying nature. The knots of woodwork, especially pine, contain much resin, which gradually exudes from the surface. This resin will speedily darken, and ultimately destroy, the covering film of oil paint with which woodwork is usually coated. The object of coating knots in woodwork with 'patent knotting composition' is to seal up, so to term it, the resin. In the earlier history of house-painting processes a mixture of red lead and strong glue-size, applied warm, was often used. The chief point in view is to stop the 'cause,' but without objectionable 'effect ;' therefore the thinnest perceptible covering—so long as it is effectual—is the best. The *patent knotting* of commerce is the article now generally purchased and used. The knots are given one or two *bare* coatings —according to the nature of the knot, and the conscience of the workman. The best knotting is the colour of dark oak varnish ; the worst is the blackest and dirtiest-looking. It always pays to have the best knotting, since 'black knotting' requires an extra coat of paint to cover the dark patches which 'grin through' any light tints. For the best work it is usually advisable—especially when the woodwork has to be finished, and perhaps hand-polished, in 'ivory-white' enamel—to have the knots cut out with a

chisel or gouge, then fill up with lead 'filling-up' in distemper. I recently had to have the door of an elaborately decorated drawing-room so treated, since, despite being fresh knotted, the resin began to discolour the work, which had received some six coats of paint and enamel, ere the room was furnished—a very annoying and costly matter. Very occasionally knots are gilded over with best gold-leaf; this is generally conceded to be an effectual plan to adopt, when gouging is not resorted to, for finest work. Knotting woodwork is, therefore, not an insignificant detail of house-painting, especially when we are dealing with a door-side; that alone, when finished in hand-polished enamel, may cost a ten-pound note to produce. 'Tin-paint' will do for common priming; good linseed-oil is the chief element required. All new woodwork requires three coats of good lead and oil paint before standing any time—viz., priming and two after-coats. This is known as 'builders' finish.' When permanently decorated it usually requires 'getting up' to a proper surface, and two or three more coats."

It is sometimes an advantage to "gouge"—*i.e.*, to cut—out a bad knot and fill the cavity with wood, wood-paste, or *carton-pierre*.

A very beautiful stain can be given to wood by rubbing it with nitric or sulphuric acid, and exposing it to the heat of a fire. In this way American hickory can be made to look like rosewood. Pine becomes red, which grows darker with increased heat.

Mending Furniture.—There is but one rule for repairing creaky chairs and tables with loose legs. They must be *carefully* taken apart, which can be done

with chisels, a knife, and hammer, and then glued and screwed or put together again as they were originally made. The old-fashioned rounds or rungs of chairs, now so seldom seen, were a great aid to strength and durability.

I have already remarked that when a drawer in a bureau table is troublesome by continually sticking or catching, take it out, find where it rubs, and plane away the obtrusive portion. If it is made of badly seasoned, green, warping wood, nail across it strips of tin. To which I add that doors of closets, cabinets, &c., which are shrunk must have strips of wood glued to their edges. In some cases strips of paper will do as a temporary substitute.

It is no exaggeration whatever to declare that two or three centuries ago the slight and trashily made article of furniture was a great exception, while at the present day it is the well-made, durable article which forms the rarity—to the great shame, be it said, firstly, of all furniture-makers, and, secondly, to fashionable "taste," which prefers slightness to strength.

This trashy and flimsy lightness is vastly to the profit of the cabinetmaker, since he can thus utilise the cheapest and smallest pieces of worthless wood by turning them into supports for light *étagères* or shelves, cross-backs and legs of spider-like little chairs, and all parts of small curved sofas, which are to be duly puttied, French polished, or completely hidden in velveteen or rep. It is not unusual to see what is considered a handsomely furnished room in which there is not one absolutely well-made or strong article which would bear careful examination or turning up. It is a pitiful sight indeed to see a load of such furni-

ture on its way from the cabinetmaker's, or the mill where it is sawed out by steam, to the place where it is to be veneered or painted, glazed, and clothed into elegance. The pieces of refuse pine wood and American greenish-yellow poplar stuck together with glue, and as few short nails as possible, look so shammy and shabby! I have wondered, in beholding them, at the marvellous boldness of their makers, who could deliberately calculate the time that such stuff would endure before its *débacle*. And as it is all destined to be broken and mended sometime or other, it is the more necessary that the art of repairing should be studied. Unfortunately, badly seasoned deal cannot be repaired into well-seasoned oak. Yet he who will take the pains to ascertain the price of the latter will be amazed to learn that so few people have it made into good, solid, strong furniture. "It is not *there* that the expense comes in." If the reader, having some sense or taste in art, would make his own furniture, employing an assistant at six shillings a day to do the rough sawing and planing, he would find that he could have strong, substantial furniture; and if he would add to this so much knowledge of panel-carving as he could acquire in a few lessons, he might make it beautiful.

A CEMENT FOR WOOD is made as follows:—

Caseine	10
Borax	5

This is carefully worked into a thickish milk-like mass. It may be used as a glue for wood or as a paste for paper. It admits of many modifications. To make a very good waterproof cement for wood, as

well as other purposes, take this cement when it shall have hardened, or after it has been applied, and wash it over frequently with a very strong extract of gall-apples. This forms, according to LEHNER, an insoluble union with caseine.

A CEMENT MUCH EMPLOYED IN CHINA to combine and make woodwork, basket-work, pasteboard, &c., water-proof is made as follows :—

Slacked lime	100
Stirred ox-blood	75
Alum	2

This is commended as being very strong and durable. It is probable that a slight increase of the alum in solution, or an addition of strong infusion of gall-apples, would improve it.

A WATER-PROOF CEMENT FOR WOODEN CASKS is made as follows :—

Strong solution of glue . . .	10
Linseed-oil varnish	5
Oxide of lead	1

Boil together for ten minutes. This cement must not be brought into connection with lye (LEHNER).

A good, strong, cheap cement for joining wood with metal or stone is made with

Carpenters' glue	50
Sifted wood-ashes	100

While the glue is soft stir into it the wood-ashes in greater or lesser quantity, according to their quality and fineness, till a syrupy mass is formed. Clay can also be combined with this mixture to make casts.

Common *peat* of fine quality (for there are different kinds or degrees of it), carefully cleaned from sticks and fibres, combined with common glue infused freely with nitric acid, submitted to strong pressure, is said to form a valuable substitute for wood, which may be used not only for repairing, filling chinks in trees, making up decayed timber, &c., but also to form blocks and planks.

I have elsewhere mentioned that shavings are utilised in Germany. Combined with glue, infused with glycerine, and submitted to pressure, they form boards which are even less brittle than many which are in ordinary use. The peculiar advantage of this artificial timber is the limitless length of the boards which can be thus made, which is often a great desideratum in flooring, or indeed in any building where piecing should be avoided. A canoe can thus be made on another as mould, in which case the shaving-cement is to be hardened by rollers. There is a book on this subject, elsewhere mentioned.

It may be observed that, as long and broad timber becomes every year more rare and valuable, artificial timber from smaller plants must certainly take its place.

Whitewash for wood is rendered more durable and glossy by the addition of liquid glue, well stirred in. It is still further improved by the addition of milk. This lasts so much longer than common wash that it is in the end perhaps ten times as cheap. When well made it has been known, when applied to the exterior of certain Government buildings in Washington, U.S.A., to last for seven years. If colouring matter, such as umber, be added, let the latter be

mixed separately with the glue, and very thoroughly, before it is joined to the lime. The addition of a few eggs to the mixture will improve it. The lime prepared with the following forms a still better and stronger wash, which is well worth the extra expense :—

Glue	60
Linseed-oil varnish	20

The varnish, while *hot*, is mixed with the boiling glue, and it is to be used at once. This is (LEHNER) useful to coat and caulk casks, especially those in which such fluids as highly rectified spirits of wine are carried. Be it observed that the hotter the mixture is when applied the more deeply does it penetrate, yet the less is in the end required.

A GOOD CEMENT FOR CARPENTERS :—

Slacked lime	50
Flour	100
Linseed-oil varnish	15

WOODWORK which is to be under water or much exposed to rain may be cemented with the following :—

Calcined lime	10
Flint sand	15
Iron (powder filings)	5
Ochre	20
Brick-dust	20

The powder must be well mixed by shaking, and, just before use, to be mixed with water.

The following may be used for JOINTS IN TIMBERS, holes and cracks, or for covering the surfaces, as it is

an excellent protective against wet. It may also be used for stone, &c.:—

Purified brick-dust	10
Calcined lime	10
Purified red iron ore . . .	10

Work this to a paste with dissolved soda. Modifications of this combination of soda with iron and brick-dust will readily occur to all who have carefully studied this work.

A CEMENT FOR WOOD :—

Slacked lime powder	1
Rye-meal	2
Linseed-oil varnish	1

To which burnt umber or similar powder may be added at discretion. This cement dries slowly, but becomes very hard. It is good for filling cracks, holes, &c.

FRENCH GLUE FOR WOOD :—

Gum-arabic	1
Water	2
Potato starch	3–5

SAWDUST, as I have explained, from my own conjecture and experiment, can be combined with cements so as to form an artificial wood, which can be easily moulded or carved, and with which all kinds of worm-eaten and decayed wood can be restored. I find that for this purpose LEHNER gives the following :—

" Take the finest sawdust and combine it with linseed-oil varnish, kneading the mass very carefully."

This, when properly combined and worked, would

form a very good artificial wood. It may be here observed, that because the experimenter finds at a first trial that the wood is too brittle or too hard, he is not to conclude that the *recipe* is good for nothing. Thus, to prepare it with glue we should take—

Water	20
Glue	1

First boil the glue very carefully, and stir into it the finest wood-dust or cocoa-nut shell powder. The quality will be improved if the latter has already been steeped for some time in a strong solution of oak-bark or gall-apples in spirit, or, instead of the latter, water. This disposes the dust to amalgamate with the glue. Stir the whole thoroughly. A commoner or coarser preparation for simply repairing is made by combining plaster of Paris, glue in watery solution, and sawdust. Common bone-dust, plaster of Paris, and glue make a good cement for light wood-dust. With a little glycerine it can be used for moulding. Add a little pipeclay, and if the bone-dust be very fine the surface will take a very high polish. Finish with oil and hand rubbing. This composition combines well with perfectly softened and macerated paper—not merely *soaked*—to form panels, which, however, to make them hard, should be pressed or rolled.

Cements for deals or boards of soft wood :—

I.

Caseine	500 grams.
Water	4 qts.
Spirit sal-ammoniac . . .	0.5 qt.
Calcined lime	250 grams.

II.

Glue	2
Water	14
Cement lime	7
Sawdust	3–4

For splits in trees, or fractures in the bark :—

Pitch or resin	50
Tallow	10
Oil of turpentine	5
Spirits of wine	5

The resin is first melted, the turpentine then stirred in, then the tallow, and finally the spirits.

I have spoken of artificial wood as chiefly made of sawdust combined with a binder such as glue. There are, however, strictly speaking, other kinds. The first of these is made from *cellulose*, which is disintegrated wood which still retains its fibre. It was discovered, I believe, by accident, in New York about thirty years ago. A stick, which fitted tightly, had been left in a cannon, when the latter was fired off. The result was that the stick was converted into a pulpy, fibrous mass, which was found to be admirable as a material for making paper. This, combined with glue, makes good boards.

Bark of different kinds is also combined in powder with glue to make wood. In all of these mixtures, where it is desirable to avoid brittleness or hardness, there must be an admixture of oil or glycerine. There is generally about $\frac{20}{100}$ of the latter to $\frac{80}{100}$ of sawdust, but the proportion varies according to the degree of elasticity or hardness required. To make

boards the mixture is passed under heavy rollers, and when dry it is further treated with alum in solution, or tanner's infusion of oak-bark, to make it waterproof. This is not necessary for ordinary work or repair.

To imitate Cedar.—Take any white wood and boil it for several hours in the following mixture :—

Catechu	200
Caustic soda	100
Water	10,000

This penetrates very deeply into any wood. It is a very good protective.

To prepare Wood for Paint.—When you have a board or box, &c., however rough, and of any kind of inferior wood, first smooth the surface, if possible by planing, or else with a rasp and glass-paper. Fill all the holes and chinks with putty, or bread and gum, or gum and plaster of Paris. Then, with a mixture of glue (not too stiff) and fine white plaster of Paris, rub over all the surface to perfect smoothness, and when quite dry remove any irregularities with finest glass-paper. Then paint as desired. This is an approved method of repairing old panel pictures, which were all made with such a ground of plaster and glue.

To repair Marquetry or Inlaid Woodwork.—This, as I have already said, and will now describe more in detail, is made of different pieces of coloured wood, glued on a panel. Take a piece of fine hard wood, such as holly, and saw it out to exactly fit the place where pieces are missing. Draw the pattern on it, and then outline it very neatly with a fine pen-

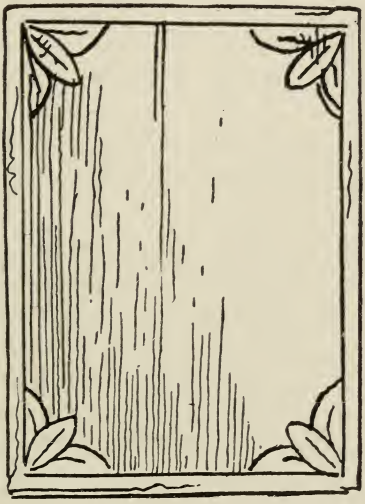
knife-point, so as to cut a little way into the wood, but not *through* it. Fill up this line thus cut with a composition of varnish and any black powder. Then with *dyes*, not oil paint or water-colour, but such as are made with spirit, colour the pattern, a separate colour to every piece. The dye will sink in and grow pale ; then apply it again, and till it is of the hue desired. Polish the whole. This is what is called Venetian marquetry. It is, very easy to make, and produces beautiful results, quite equal to the sawed-out and inlaid work. It is, moreover, much more durable and far less expensive. MANDER'S dyes are used for such staining.

Even a single inlaid figure of wood, set into a panel, as in the back of a chair, gives a character, and apparently greater value, to the whole. Such inlaying is easily made with a fret-saw. If we take two thin plates of wood, one dark and one light, and saw the same pattern out of both, we can then set one into the other, and so make two inlays by one process. *Parquetry* is large inlaying for floors. For this it is well to study such forms as can be *set together*, as, for instance, squares, diamonds, crosses, T's, and the like.

Violins, guitars, and lutes can be beautifully adorned by the Venetian process. As the colours do not wear away, and cannot scale off like common inlaying, it will be seen that it is by far the best way to decorate them. Furniture of all kinds can be ornamented in the same way. It is peculiarly appropriate to picture-frames. It being very little known, objects thus prepared meet with a ready sale.

When a corner of a pane in a window, as often happens—as also to the glass of a picture-frame or mirror

—is broken away, we can easily make or have made a small ornament which will fit into the corner and conceal the defect. This can be made of wood, *papier-*



Mirror with Ornaments of Papier-mâché or Wood-Paste.

mâché (which is best), or hard putty or cement. It may be gilded or painted. Windows may be prettily ornamented in this manner, even if not broken.

ON REPAIRING AND RESTORING BOOKS, MANUSCRIPTS, AND PAPERS

WITH DIRECTIONS FOR EASY BINDING AND PAPER-MENDING — BOOK-WORMS

It happens often enough that some valuable old manuscript or early printed work, if not destroyed as useless, is sold for a trifle because it is torn and worm-eaten or otherwise injured. The loss to literature from this cause has been terrible, and it is all the more so because in most cases it was the result of sheer ignorance.

Paper is a composition of linen, cotton, or other vegetable fibre reduced to powder and then combined with *size*, which is a kind of glue, paste, or binding medium. Therefore paper can be mended by using, in the soft, macerated, or pasty form, *paper itself*—which very simple fact appears to have been hitherto a secret from the greater portion of mankind. That is to say, having a piece of paper with a small round hole in it—looking as if some one had fired a shot through it—take another piece of paper of the same quality and reduce some of it to a very fine powder or mash it fine with a knife, combine it with good flour-paste infused with a little clear white glue, and make a soft paste with the powder ; then, laying a porcelain

tile or piece of tin under the sheet, with a hole in it, to prevent sticking, spread the paste, which is really soft paper, with a knife over the hole. When dry it will be mended permanently. Observe that the pulp must be a fine *paste*, not merely paper mixed with paste—*i.e.*, lumpy and stringy, but soft. Secondly, that a better "binder" or size than flour-paste is one made from scraps of parchment boiled, till all the gelatine is extracted. Take the latter and let it boil till thick. It makes a finely glazed surface.

Do not begin to do this with a book, but with a sheet out of which holes have been punched. It is delicate work, and you must not expect to succeed in it at once. But in time, with care, you will remake the paper with great skill. There are workmen who can even reunite torn edges in this manner so that the mending is almost imperceptible. This is remaking paper with paper. In some cases it will suffice to simply neatly paste a piece of paper over a torn-away space. This may be done—as in most cases—very clumsily, or it may be performed artistically and daintily. In the latter case, using a very sharp and specially *thin* bladed penknife, shave down or scrape away the overlapping edge, and apply the paste sparingly with the point of a camel's-hair small brush. Before it is quite dry lay the leaf on a smooth, hard surface, and with the penknife or a burnisher flatten down the thinned edge to an uniform surface. This also requires a little practice, but when learned the artist may effect miracles of restoration. One may, and that not infrequently, buy for shillings books which when mended sell for many pounds.

It often happens that we find some curious little

old book which has been sadly cut or worn, almost down to the type. Take it, and with a flat rule carefully cut out every page, leaving just a little rim of margin. Then having obtained old paper corresponding to your text, or good modern hand-made Dutch, using strong glue-paste or flour and gum-arabic, or paper-paste, make borders, on which paste the old pages. If you have old paper—there are dealers who can supply it—you may do this so well that the juncture will be hardly perceptible. In any case you will greatly enhance the value of the book. In this, as in all such work, never attempt to restore anything of value till you shall have succeeded by experimenting. This is very seldom done, and yet books thus restored sell for a price which must make the work very profitable. One reason, however, why we see so little of it is the *extravagant* price charged for all such work by the agent who supplies it.

The prices paid for books thus restored and mounted are extremely high, simply because there are so few people who know how to do it well ; and yet, as any of my readers may find, the art is an easy one, requiring only neatness and care. There are very few libraries where such restorers might not be employed, to the very great profit of the collection. All purchasers for libraries are continually rejecting books because they are tattered and worn or " holey," which could be sent to the hospital and doctored into value. And it is, indeed, to be regretted for the sake of the public that our great libraries have not all shops attached where duplicates and damaged rarities restored could be sold at fair, not fancy, prices. For it is firstly the great librarian who sees and rejects the

most books, and who could do an immense amount of good, and greatly stimulate an interest in collection and literature—and make money—if he would also facilitate acquisition. The art of restoring and of mending is as yet so much in its infancy, and is so little understood and practised, that there is not one book in a thousand, even of *rariora* and *curiosa*, preserved as it might be.

It may be worth while to lay some stress on the fact that many persons, especially women, if they will take a little pains to experiment, can easily make a living by thus restoring books and injured documents. There are, indeed, many other means of earning money indicated in this work.

A CHEAP AND DURABLE VARNISH specially made for bookbinders is prepared as follows :—Take coarsely powdered gum-copal, add to it oil of thyme (*oleum thymi serpilli*) or pure oil of rosemary (*oleum rosmarini*), sufficient to form a solution. Pour off the superfluous liquid, and mix the remainder with sufficient alcohol to dissolve it well. In making take only so much of the oil of thyme or rosemary as will cover the copal, and of alcohol about eight or ten parts to the whole. Special varnishes, and perhaps better, are known to many bookbinders, who will sell them, or inform you where to obtain them. I know of none so good as that of SOEHNÉE, which is, however, very expensive, costing about ninepence per ounce. It is rather brittle, however, for pictures.

When a book is dog's-eared, or its leaves have been turned, if the paper be of a thin, poor quality, its chances of restoration are better than if it were good and stiff. In the former case damp the leaves one by

one with water in which a *little* gum-tragacanth has been infused. This is not so much an adhesive as a mere stiffener, and is used as such for laces. Then flatten them, putting a piece of smooth white paper between every leaf.

There is, I fear, nothing to be done where the reader is so utterly devoid of all the instincts of a gentleman or a lady as to turn over a stiff, thick, highly glazed paper to mark the place! I have just found this done in a magnificently illustrated work from a circulating library, and, to aggravate the offence, it was on pictured pages! I would here remark that if every reader would keep by him a piece of indiarubber or eraser, and obliterate, or at least render illegible, all the scribblings made on margins, this detestably vulgar practice would soon be at an end.

It may be observed that to repair pages which have been torn across, or engravings, the rent is usually *transverse*—that is, such as to leave a small flap edge. If we take very strong gum in very minute quantity on the point of a camel's-hair brush, we may often succeed with great care in perfectly reuniting the edges. Observe that in this, as in everything, the mender should not draw his conclusions from the first effort, which will probably be a failure, but from frequent careful observation and experiment. There are marvellously few people in the world who take the pains to become really good menders of anything—excepting lace and the like—hence there are few things mended at all except by botchers and amateurs.

Ink-Stains can be removed from paper by laying underneath the blot a pad of clean blotting-paper or

fine muslin. Take a fine sponge, dip it in lemon-juice, and press it gently on the stain, so as to moisten it. Then with a clean, white, soft rag, folded into a pad, press on the spot, and the pad, lifted off, will remove a little of the ink. Repeat this process a few times, taking care to change the pad in your hand every time *to a clean* spot. Do not try to *rub* the stain out (as most people do), but to *draw* the ink away or out by sucking up or by absorption. If you simply rub or press the ink in again which has just been drawn out, you will only make bad worse. And here I would observe that by this process of pressing, absorbing, and changing the "sucker" applied, you can draw appalling stains out of almost anything. You cannot, of course, prevent chemical action or change of colour, but in most cases this is the best process.

It is better to begin with lemon-juice and a little salt and water where the paper is thin. When it is strong, a mixture of muriatic acid and water generally extracts ink.

In a great many cases the staining fluid can be drawn out by absorption before any chemical change in the colour of the stuff can have been effected. Therefore it is all-important to know how to do this yourself *at once*, and not wait till it can be sent to a dyer or scourer or cleaner. In a few hours' time that which could have been promptly extracted will be past all cure. When you spill ink on paper, promptly apply, first of all, blotting-paper, and then try absorption. If any stain remains then, apply the acid.

To take out a Grease-Spot.—Heat an iron (I generally effect it with a burning cigar), and hold it as near as possible to the stain without burning the

paper. If this be well done the grease, wax, &c., will rapidly disappear. If there are any traces left, place on it powdered calcined magnesia for a time. This is also a good means to extract grease, wax, or oil from cloth. Very often, where lemon-juice or acid would ruin the colour of a cloth or other fabric, chloroform will take out the spot and leave the colour unchanged.

Bone, well calcined and powdered, is an excellent absorbent of grease. It should be remembered that all such processes must be renewed, for after the powder or cloth applied has received a certain quantity of the grease or stain, it ceases to be taken in. A gentle pressure or rubbing, after laying paper over the powder, facilitates the absorption.

The celebrated ATHANASIUS KIRCHER, who wrote in the sixteenth century, has left an amusing account of how he one night, stopping at a convent in Sicily, took a book from the library (it was STEPHANUS FAGUNDEZ' *In Præcep'a Ecclesiæ*)—"a new book and elegantly bound"—and spilt over it and in it all the midnight oil from his lamp! In great alarm he sent for quicklime, but there was none to be had. So he bade the monks bring him some *bones*, which he quickly calcined and pulverised and applied. And the next morning there was not a trace of a spot, only a little smell of oil, which soon vanished. He adds, that plaster of Paris would have done as well.

Ascertain carefully the nature of the spot before trying to extract it. For resinous substances use spirits, or eau de cologne, or turpentine. Benzine extracts several substances.

An old recipe for removing ink-stains was to take

a spoonful of good aquafortis, in which break a piece of chalk the size of a large barley-corn ; add two spoonfuls of rose-water and one of vinegar. This should be mixed in a clean glass and left to stand for several hours. It is to be applied with a piece of new sponge, by pressure, and not too freely nor too long. When the paper is nearly dry renew the process, and when the ink shall have disappeared, promptly wash out the acid with pure water and a clean linen rag. (But it is *too strong* for many fabrics.)

When the ink does not penetrate the paper it can be removed by erasure with a sharp penknife, or a preparation of vulcanised indiarubber and powdered pumice-stone, sold by most stationers. When this latter does not "bite," its action can be aided by very slightly moistening it. After erasure rub the spot scraped with very finely powdered pumice-stone, and polish with a burnisher or any smooth substance.

Even when an inkstand has been spilled over a printed or long-written page, we can by prompt action extract the new ink and leave the old plain as ever ; but the reader who expects to work this miracle of changing night into day must not wait till the accident happens to first attempt to remedy it, or he will probably fail. Let him first of all, not once but often, pour ink on some waste and worthless page, and then experiment first with the blotting-paper, then with the dilute acids and the padding. The time will not by any means be wasted.

A fresh ink-spot can be easily removed from paper by rubbing it with a finely pulverised mixture of saltpetre, sulphur, alum, and pumice. If the spot is an old one, moisten it first a little with water.

Ink-spots, &c., in old MSS. were sometimes ingeniously covered by ornaments in gold or colour.

When an entire page or many pages of a book are missing, it often happens that, at much less expense than would be supposed, an ingenious printer can restore the whole. There are many books for which it would be worth while to have the type cast, for even with a page thus restored the book may be worth ten times as much as if it were wanting. Missing pages are often supplied by photographic fac-similes from another copy.

It was only yesterday, as I write, here in Florence, that I heard a tourist declare that there was nothing worth buying to be found, and that everything curious was snapped up at once. To which I could not assent, never having seen so many objects as of late which I regarded as great bargains. But they were all *dilapidated*, and the tourist generally likes to see everything in splendid condition. To him who can restore old books and ivories and leather-work and panel pictures, there will be no lack of bargains for a long time anywhere. The men who sell are not all such marvellous experts in mending up, repairing, and forging as literary dealers in the wonderful would have us believe. If they were so clever they would not let valuable panel pictures split in two before their eyes from ignorance of knowing how to straighten and tack them at a penny's cost. There is abundance of clever forging, of lying ivories and silver-work and sham antique leather, but of restoration of smaller or of single objects there is very little ; and there is, as I have said, in this a vast field for every collector who knows enough to make practical application of what

is taught in this book. It is so far from true that everything is now snapped up, that I confidently assert that there is hardly a *bric-à-brac* shop in Europe in which a skilled repairer cannot find a bargain, and in most cases several.

It will often be of service to the mender of books to be able to prepare parchment-paper for himself. If we take a mixture of one part nitric acid to three of water—the proportions varying very much with the quality of the acid and of the paper—and dip into it a piece of soft unglazed paper, the latter will at once harden into a substance like parchment. It should be at once washed in changes of pure water. I may here observe that neither in making this nor anything else should the operator be satisfied with a single experiment.

Regarding paper, there are certain curious facts worth knowing by every reader. Before the invention or general use of window-glass, a very transparent kind of paper was, according to KIRCHER (*De Secretis*), prepared as follows :—

Take paper from the mill, not as yet sized, and mix with it to six parts of turpentine two of mastic. This really makes a very clear, or at least diaphanous, medium, which may be used for temporarily repairing broken glass windows.

The same writer informs us that if we take fine parchment (*pergamenam hædinum*), prepared without lime, or naturally dried, we should lay it in water, which will just cover it, in which has been well infused boiled honey and the white of eggs. This was used to repair coloured glass windows.

There is also given in the *Zauberbuch* of JOHANN

Wallberger, Frankfort, 1760, a recipe for the same purpose :—

"Take parchment prepared without lime, and steep it in a mixture of thick gum-arabic dissolved in water, the yolk of eggs well shaken, and clarified honey."

It is worth observing, as regards these recipes from old works, that while those founded on modern chemistry and experiment are generally cheaper and apparently better, the former are often more *durable* in effect, and were, indeed, more thoroughly tested. There were a great many parchment windows in those days, and there are none now. And in these old works of Porta, Weckerus, Tenzelius, Kircher, Alexander of Piedmont, Mizaldus, Valentine Krautemann, and many more of which I have a large collection, there are many curious prescriptions, many of which I have seen revived from time to time of late years as modern scientific inventions—on which subject an interesting article could be written.

A weak solution of oxalic acid in water is often the best to remove ink and other stains from strong white paper or linen. It should be applied by gently pressing or *dabbing* (not rubbing) with a cotton pad. As soon as the stain is removed, dab it again with clean water. Take good care, however, that there are no scratches or cuts on your fingers, for if the acid gets into them it will cause great pain.

I may here mention that the old bookbinders' paste was made as follows :—

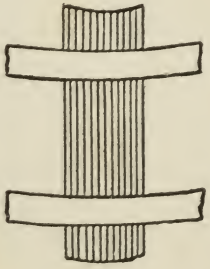
Take a quarter of a pound of starch, steep it a quarter of an hour in water, and stir it till it is milky. Add a pinch of alum, and boil it once more.

This was said to keep better than paste made from

flour. (Add a few drops of oil of cloves or carbolic acid, and it will keep very well.) Flour can, however, be used instead of starch, and a good adhesive be the result. A little glue very much improves it. There is a great difference in the quality of cement made from bread, as the condition of the latter has been changed by fermentation.

BINDING.—Repairing books is nearly allied to *binding*, and the latter is, in perfection, a somewhat difficult art. Yet it is not at all difficult for a careful person to bind up many works in such a manner that they will bear much reading, and with a little artistic skill look very well. This may be effected as follows :—

When a book is stitched together, there are sewed into the back two or more cross pieces of string or strips of muslin, which project a little on either side, and which, by being pasted down inside the cover under a leaf, hold the book and cover together. This is further strengthened sometimes by another strip of muslin. When the back is firmly gummed or pasted to the book, so as to bend with it, it is called a flexible back, which also adds to the strength of the whole.

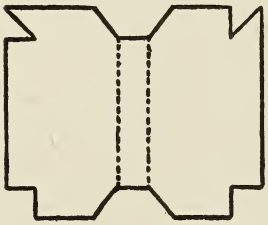


If the reader will now take a simply sewn or stitched book, without binding, and will place across its back two or more strips of parchment, and glue them on with the strongest possible cement—mastic being the best, but acidulated glue or flour-paste with glue, or even dextrine-paste, will

answer the purpose—and if he will again paste up and down over these a strip just the width of the back, he will have all that is necessary to make a strong binding, for this will hold as well as the strings. Note that the parchment strips must first be thoroughly wet through and macerated, or crumpled till quite soft. Again, that when the paste is nearly dry the strip should be rubbed in.

Next cut out two pieces of *strong* pasteboard, each a very little larger than the length and width of the book. These are the covers.

Now paste the outside of the *straps* exactly to the inside of the covers, leaving just enough space for opening and closing. When dry, the book should open and close easily. Then take the outer cover of leather or cloth, which is cut in the shape indicated in the accompanying outline, paste it well over the back, and then turn the edges over and paste them down over the cover inside, so as to form a narrow margin, as may be seen by examining any book. Also turn down, before doing this, the edges at the ends of the book. The binding will be much stronger if, after pasting the ends of the parchment strips to the covers, we paste over them in turn good, strong pieces of paper, close to the back, to prevent the strips from pulling up.



If there be fly or blank leaves on the sides of the book, paste one of each down over the inside of the cover. This will conceal the margin and add greatly

to the strength of the book. But if there be none, you can supply them, firstly, by a method which will make your binding even stronger than that of most books. Take a very strong piece, let us say, of Whatman's or any other good tough linen drawing-paper, just of the size to cover the whole book—that is, back and sides. Cut in it four slits, and pass the strips which are to bind the book to the cover through, and gum them down, and then paste the fly-leaf thus added down over the strips. But it will answer every purpose if you simply gum fly-leaves on by a very narrow margin of "adhesive." All of this will become clear to any one who will carefully examine a book. And anybody who has the dexterity to fold a letter neatly or do up a parcel properly, can in a short time, after one or two experiments, succeed in binding a book in this manner. I have observed that those who fail as amateur bookbinders generally do so because they attempt too much too soon, and aim at producing elegant masterpieces before they have learned to manage with ease such common work as I have described.

Though this manner of strip-binding is little known, it was, strange to say, the very first ever practised; for, according to OLYMPIODORUS, one PHILATIUS was the first who taught the use of *glue* to fasten written or blank leaves together, for which great discovery a statue was erected to him. Binders were called among the Romans *ligatores*, as they are still in Italy, *legatori;* and it was here, indeed, that I myself learned the craft, as I now generally bind my own books. Those who prepared and sold the covers for Roman booksellers were called *scrutarii*.

There is a very easy way to bind up pamphlets, MSS., or letters when they have any margin for a back. If you cannot have them stitched—which, though difficult to an inexpert, can be done for a mere trifle—then sew them together across from side to side. Where the pages are of great value, gum them together by a *very narrow* doubled or folded strip of adhesive. This done, bind as before, or else simply paste on a cover of drawing-paper at the back, and the fly-leaves to the sides. A great deal of loose literature, flying leaves, clippings from newspapers, letters, &c., can in this way, at no great expenditure of time or money, be converted into really valuable books.

I may here observe that cloth for binding, thin leather, and even common parchment or parchment-paper, are much cheaper than would be supposed, and that the average cost, all expenses included, of binding a duodecimo book in these would only be from threepence to a shilling. Any waste parchment will serve for binding.

Any person, however, who can emboss leather with tracer and stamp, even though but a little, after a week's practice, can decorate and ornament books so as to greatly enhance their value. Nor do I exaggerate when I say that here is a field in which any person who can draw or copy decorative patterns moderately well might make a living. The reader will find the fullest details as to how this is done in my *Manual of Leather Work*. (Price 5s. London, Whittaker & Co., 2 White Hart Street, E.C.) In the present work I can only state that it is executed as follows :—Bind your book with cardboard in fairly thick, hard, and

firm brown leather ; there is a kind made for the purpose in Germany. Draw the pattern on it, or else draw it on paper with a crayon-pencil, and rub it from the back on the leather. This done, go over it with the fine point of a miniature brush in Indian ink. Dampen the leather slightly as you work with a sponge, and mark the outline with a tracer and stamp the ground with a matt. You may leave it brown, but if the work be coarse, I advise painting the whole with ink or Indian ink, and then coating it with SOEHNÉE's varnish, No. 3. Rub this down well by hand.

If you can supply the design (which should always be bold and simple), any wood-carver will, for a few shillings, execute it in *intaglio* on a block of wood, which should be at least one inch in thickness, and also have a transverse piece screwed to its back to prevent its warping. With this you can stamp off as many covers as you want. Retouch them by hand with tracer and stamp. If blackened, and then touched up with gilding and varnished, such books are very attractive, and should sell well. Any person who can design, or even trace, a pattern can have it cut on a block for a few shillings, and anybody having such a block can print off any number of impressions in damp leather, and retouch them with stamp and tracer, and glue them to cardboard covers, for books or albums, and sell them at a good profit. Yet, though this has been clearly set forth by me several times in manuals, &c., I have never yet met with a single amateur who has attempted it. There is as a rule far more suffering in this world from *laziness*, inertness, and an indisposition to *try* to do something

than from any other contaminating influences which lead to poverty.

When a book is even woefully dilapidated, so that there is no margin to stitch, do not despair. First separate every leaf, smooth it, and, if necessary, dampen it with a slight infusion of tragacanth. Then, if there is even the twentieth part of an inch of margin left, take strips of good, tough, thin paper, and with care stitch the leaves to these strips. For some severe cases you must use very thin transparent or tracing paper to gum over the text, but which must be visible through it. This, if neatly done, does not look so badly as it would seem. If one strip be folded and used to connect two leaves, the stitching and binding become easy. I have already described how to restore margins and fill worm-holes.

I think that if any person of literary habits will consider all that is written in this chapter, and will begin to practise it with deliberation and care, he will surely succeed, and find it a very profitable and agreeable occupation. All of such men have pamphlets, MSS., autographs, letters, newspaper clippings, and papers, which, if classed and made up into book-form, would be more available for use, and far more valuable. I say nothing of repairing old books ; it speaks for itself as an easy and lucrative employment. And it may be observed that a young man who can thus bind and repair would make a most valuable assistant-librarian, though the business can be mastered very soon indeed ; and it would often happen that in choosing a secretary, where there are many papers to file or a library to look after, or an assistant in an antiquarian book-shop—particularly the latter—pref-

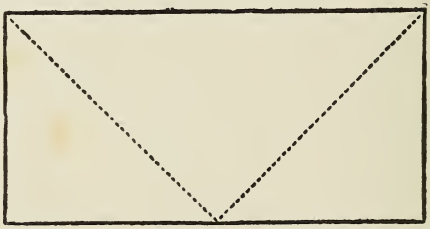
erence would be given to one who had mastered practically what is taught in this chapter. And as on board ship the best sailor is generally the best mender —every old tar being proverbially skilled in repairing and having a quick eye for emergencies, even on shore—so the one who can rehabilitate and "form" books will probably be a good assistant in all things.

It may often happen to a writer or copyist that he has occasion to erase a word, and cannot write over the space lest the ink should spread. In old times this was remedied as follows :—A very little juniper gum, levigated to the finest powder, was rubbed over the spot with a soft linen rag.

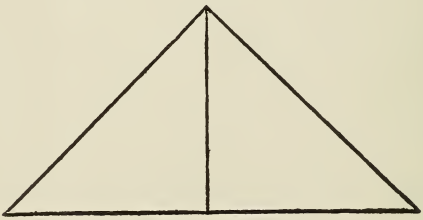
In all kinds of repairing or technical work it is sometimes necessary to draw circles when the artist has no compasses. Yet this can be done to perfection, almost by free-hand, and very easily. Take several sheets of paper or a blotter ; lay on it the piece to be drawn on. Take a pencil in the fingers, as is usual, rest the hand on the nail of the little finger as a point —having previously pulled the sleeve of his coat well up, so as to get a full view—and then with the left hand draw or revolve the paper. In most cases a perfect circle will be the result. This is admirable practice for learning to draw circles entirely by free hand, as may be found by experiment.

Paper can be made, if not absolutely fire-proof, at least deprived of inflammability, by being steeped in alum-water, or in *oleum tartari per deliquium*, or oil of tartar. Stationers might find a sale for such paper. If the document which was thrown by a certain Duchess into the fire had been thus prepared, it might have been rescued by a bystander before it perished.

The art of preservation, or prevention of injury, is allied to restoration, for which reason it would be well if more people who send books by mail would use protecting corners, which can readily be made by anybody with a pair of strong scissors from thin sheet brass, tin, or iron. Take a piece of metal of a rectangular shape, as follows :—

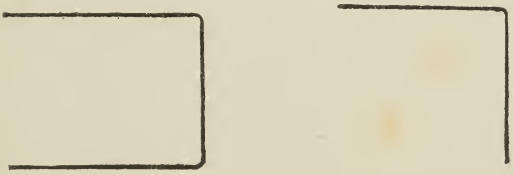


Then double it into a triangle over a piece of cardboard, or of wood, exactly the thickness of the cover of the book :—



Very valuable books should be kept in boxes of thin metal, especially in India. Such cases should not be made to open and shut with a hinged lid, but with a covering, and like a cigar case. Such cases, or at least metallic guards, should also be used when a book is wrapped and tied in the usual manner and

sent by mail. I am quite sure that at least every other book which I have received by mail during the past year has shown on its edges melancholy scars from its strings, reminding one of the wounds which the heroic red Indian retained from his bonds. A guard is simply a piece of sheet-metal, bent as follows, once or twice :—



These guards are invaluable for packing books in trunks. Their price is trifling, and in the end there would be great economy in using them. Books should not be packed very tightly together on their shelves. It bursts the binding, especially of modern works in boards and paper. The old parchment flexible bindings were in every respect better, and they could even now be made far more cheaply than is generally supposed to be possible. I have before me a book nearly three hundred years old, bound in skiver parchment (split, or very thin), which has evidently been much used, yet which is still in good condition. But parchment need not be prepared very carefully for ordinary binding, and it could be sold for half the price charged by law stationers for what is used to write on. In the United States one must pay much more for a sheepskin than for a sheep, indeed in some cases three or four times as much—that

is to say, the skin as a parchment in New York costs as much as three sheep in the Far West—and yet the expense of bringing the skin to the East and of tanning it are in no proportion whatever to the stationer's profits.

Any one who will examine an ordinary old parchment-bound book, such as lies before me, will see at a glance why it must be more durable than a modern binding. In the modern book the *stiff* back rises full to the edge, or generally *above* the level of the sides, and is made of muslin, paper, or at best of soft leather. Therefore in time it breaks from pressure and friction, or wears away. The parchment or vellum had in most cases this back-edge put back or kept down as much as possible, and the tough covering was all in one piece. It is very true that it is not possible to obtain plain, old-fashioned parchment now, and that those who would have vellum, or even sheep, must pay an enormous price for it. This would not, however, be the case long if there were as great a popular demand for parchment binding as there now is for flimsy muslin. Those who prefer the former will find no difficulty in having it made for them, and in binding their books themselves according to the directions which I have given.

I shall in the chapter on *Papier-mâché* show how covers for books may be cheaply made at no great expense, which may be beautifully embossed and are extremely durable. This is, briefly, by having a flat mould or die, on which lay alternate coats of paper and firm paste (into which glue and alum enter), then passing over them a bread-roller, continually adding paste and paper till the whole is complete. When

finished, rub in black or any other colour, then rub in oil, rub again, apply SOEHNÉE, No. 3, and finally rub by hand. This will make very beautiful binding.

It is much to be regretted that, although there has been of late years, owing to machinery and patent processes, such immense production of cheap and showy binding, as shown in photograph albums, there has been as steady and rapid decrease in quality, strength, and durability. It is becoming unusual, even in very expensive books, to find one which can be honestly and well opened or is well stitched. I have, since writing that last word, tested it with two books recently published, one costing six shillings, the other a guinea. The latter was fairly well put together and "held," but was warped in the stitching and pasting. It was "bad work." As for the six shilling book, it cracked *clear through to the back* at every page which I opened, and yet I did not open it very widely. I should say that any amateur who could not learn to bind books better in a month or six weeks than these were bound must be stupid indeed. The examination of a number of other books shows that what I have said is now generally true, and that even very expensive and pretentiously elegant works are not half so well bound in reality as were common and cheap school-books two hundred years ago. This I have also confirmed by examining a number of the latter bound in parchment, which bid fair to last for centuries to come.

Should this cheap, trashy, and showy style of binding continue, and with it a constant rise in the price of everything made by hand, the result will be that everything durable will be made by "amateurs"—

that is, by people who to artistic spirit unite a certain personal independence. Owners of libraries will bind their own books, or else employ people who will work as artists, and not like mere machines. The vulgar and ignorant will continue to buy showy, cheap duplicates—induced by hearing, " 'Ere's an harticle, mum, that we're sellin' a great many hof"—while the cultured will prefer the hand-made, which is not necessarily more expensive. In fact, if the unemployed in England—or the victims of the wholesale steam trash-maker—could be taught easy hand-work, as they all *can* be, it would be possible to not only vastly relieve national poverty, but we could have a variety of articles of better quality. For it appears to be, by some strange law, a *fact* that, with all the improvements in machinery, men can still make by *hand*—and well—pictures, clothes, shoes or boots, bookbindings, and works of art generally—that is to say, anything in which skill or character can be shown ; while, on the contrary, in all such matters machinery, instead of making any progress, is, owing to competition, actually falling behind ! Scientific and other journals are continually boasting of new discoveries and improvements, but despite this the jerry-built houses of three-fourths of London, the sawed and glued cheap and vile furniture (made by scientific steam) with which they are filled, the average quality of everything into which skill and taste are supposed to enter, show that this boasted "end of the century" is also rapidly coming to an end in good taste and the quality of its work.

He who will learn to *mend* with care, taste, and skill, firstly his books, will find that to progress from

this to binding and to making elegant covers is only going from A to B. The binding of the olden time, while it was incredibly strong, vigorous, and quaint, was extremely easy to make, as I have satisfied myself by much examination and personal practice. The stitching was not with the weakest and cheapest cotton-thread ; still less was it with wires too thin for the purpose ; it was executed with linen pack-thread, *from the top to the bottom of the page*, in three or four stitches, so that the book could really be opened and bent back till the covers touched without injury to it. All of which could be given to-day with the parchment covers at the same price which the book now costs, and to pay the same profit, were it not that public "taste" prefers showy trash. Beyond good, strong *stitching*, all the *necessary* process of binding is very easy. It requires neatness and care, and some practice, but it is decidedly not difficult. He who has mastered it will find that other kinds of mending, and also the practice of allied minor arts, are simply the succeeding letters of the alphabet.

It is a fact, to which I invite attention, that dilettante amateurs of books invariably understand by binding nothing more than its refinements and easily ruined adornment, which books had better be without. Amateurs of this class always attempt at once the most difficult work, and generally fail. As a rule, almost without exception, the prize specimens of modern binding seen at exhibitions are chiefly remarkable for ornament, which will not endure handling or rubbing, such as surface-gilding.

Pamphlets or letters, &c , can be bound with "eyelets," and the clamp or punch which is sold with

them. Or they may be simply gummed together, in which case use the powerful fish-glue, which holds perfectly.

The easiest and most effective method of side-binding, or where leaves are held together by passing the tie through from side to side, is as follows :—Have by you strips of metal, say sheet-tin, one-fourth or one-third of an inch in breadth ; also small rivets or tacks. Take two strips of the same length as the pamphlet or papers to be bound, and strike holes in them with a brad-awl and hammer, on a solid piece of wood, at regular distances. Then place these strips on the book, and drive the rivets through the holes. Turn the whole round, and laying the other side on an anvil or a reversed flat-iron, flatten the points of the rivets so that they will hold. Any old tins, such as are thrown away in such numbers, can be made to supply strips. A strip of parchment or strong paper bent over to form a back can then be pasted over the strips to improve the appearance of the volume. Any tinman will, for a trifle, supply these strips and punch the holes neatly for use. They should be found in every library, and ought to be in every stationer's. It may be observed that in inserting the rivets or tacks you should place them alternately, one on one side and one on the other. A lighter form of this binding is to take a flat-headed drawing-pin, similar to those used by artists, and have a round, flat tin or brass disc, like a thin sixpence or threepenny-bit, corresponding to it. In the latter punch a small hole, and rivet as before. Tinmen will also punch these discs ; in fact, they often throw away a great many cut from certain kinds of work.

Where the reader may have a great number of books to bind, he will find it an economy or a means to secure good work to hire a girl who is an experienced book-stitcher to come and work for him. He can thus be *sure* of having his works *well* sewed from top to bottom with strongest linen-thread in ancient style, instead of their being shabbily wired (and all wiring is shabby, since the thin does not hold, and the thick bursts the binding), or still more shabbily looped together with weak cotton-thread. This effected, he can easily do his own binding. He may not rival a Grolier, or turn out such exquisite "gems" as require to be kept in caskets, and are utterly unsuitable for use or reading, and, like most "elegant and unrivalled" modern binding, marvels of tooling and gilding. But he can most assuredly hope to bind strongly in parchment as books were bound in the olden time, and if he chooses to also ornament them with richly stamped leather covers, he can in a short time learn to do the latter, as may be seen in the *Manual of Leather-Work*.

The great test of excellence in a book is, Can it be freely handled and read without injury? The most careless examination of most books will convince the reader that this test is almost unknown. The exquisitely whitened vellum bindings of Florence and Venice, which are stained almost with the pressure of a lady's clean finger; the photograph album, so beautifully stamped in leather as thin as blotting-paper, which scratches and wears into shabbiness in a week, if often opened—all the show-pieces of exhibitions will not endure *use*. And it seems as if, after all the binding of this decade shall have per-

ished, that of the common, cheap books of the seventeenth century will be as good as ever.

A great number of the adhesives and cements mentioned in this book are quite applicable to mending bindings or making paper stick to paper, &c. The following is, however, not only a paste, but also a glaze, and is extensively used as such on labels, boxes, and cards :—

Boil borax with water, and work it thoroughly into caseine till it forms a clear, thick, and extremely adhesive cement, which is also much used to varnish leather or muslins.

It is often desirable to have a varnish or glaze for the covers of books, and still more frequently a paste, which will hold very firmly and yet not penetrate, as glue and paste very often do.

To make such a cement, mix heavy solution of warm glue with freshly made starch or flour-paste. Add to this one-fourth part of turpentine and one-fourth of spirits of wine. This excellent cement is applicable to many purposes.

To paper walls *well* we make flour-paste, and to every quart add ten grammes of alum dissolved in hot water. Then wash the wall with glue-water, and cover the paper with the paste. The alum and glue form a combination which is leathery and insoluble, and not only arrests decay, but clings with great force. Most wall-paper put on with common paste decays more or less in time, and becomes simply poisonous.

A STRONG GUM OR ADHESIVE FOR PAPER, CARDBOARD WORK, OR BINDING :—

I.

Dissolve :—

Gilder's glue	100
Water	200

Add to this :—

Bleached shellac	2
Alcohol	10

II.

Dissolve together :—

Dextrine	50
Water	50

Unite the two solutions thus formed ; pass them through a cloth, so as to fall into a flat mould. When dry, use by dissolving in hot water.

American glaze for postage-stamps :—

Dextrine	2
Vinegar	1
Water	5
Alcohol	1

Stamps are, however, very often surreptitiously removed by means of moisture. The following recipe renders this difficult. It consists of two preparations, one of which is applied to the stamp and one to the letter. It is particularly needed in America, where, according to a statement in a newspaper, *nearly one-third* of all the postage-stamps are removed from letters, cleaned, and used over again.

I. *For the Letter.*

Chromic acid	2.5 gr.
Caustic potash . . .	15.0 ,,
Water	15.0 ,,
Sulphuric acid	0.5 ,,
Sulphuric copper-oxide of ammonia	30.0 ,,
Fine paper	4.0 ,,

II. *On the Stamp.*

Sturgeon's bladder in water .	7.0 gr.
Vinegar	1.0 ,,

The chromic acid forms with the glue a substance insoluble in water, which causes the stamp not to yield to moisture. The two should be kept in two cups, and the letter first smeared with one and the stamp with the other. I have read of a physician who, finding that his postage-stamps were often stolen, adopted the precaution of giving their backs an application of croton-oil, or some similar powerful "anti-thief-matic," the result of which was great temporary illness in his landlady and her family. For this recipe the reader must apply to a chemist!

Eder's Gum for Photographs.—Dissolve oxyhydrate of ammonia in vinous acid, to one part of which add twenty of starch-paste.

Cement for Leather or Paper in Binding Books, &c.—Take 1 kilogramme of wheat-flour, and make it to a paste with 20 grammes of finely powdered alum. Boil this till a spoon will stand upright in it. Cover the cardboard or cover with this, lay the leather or

muslin upon it, and then with a roller press one upon the other. Leather should first be damped. Care must be taken that the paste be not too moist ; secondly, that it is laid on very evenly and thinly.

Engravings or texts which have had a piece torn out can be restored as follows :—

Obtain a photograph from a perfect copy on corresponding paper, then with gum set it in, so as to supply the deficiency.

As the ravages of the *Book-worm* form an important item in mending books, and as there is always some interest for collectors regarding this much talked of and rarely seen insect, I take the liberty of reproducing from the American *Science* of March 24, 1893, an article on the subject. An appropriate motto for it might be :—

" Come hither, boy ; we'll hunt to-day
The book-worm, ravening beast of prey."

THE RAVAGES OF BOOK-WORMS

At a meeting of the Massachusetts Historical Society, held February 9, 1893, Dr. Samuel A. Green, after showing two volumes that had been completely riddled by the ravages of insects, as well as some specimens of the animals in various stages, made the following remarks :—

For a long period of years I have been looking for living specimens of the so-called " book-worm," of which traces are occasionally found in old volumes ; and I was expecting to find an invertebrate animal of

the class of annelids. In this library at the present time there are books perforated with clean-cut holes opening into sinuous cavities, which usually run up the back of the volumes, and sometimes perforate the leather covers and the body of the book ; but I have never detected the live culprit that does the mischief. For the most part the injury is confined to such as are bound in leather, and the ravages of the insect appear to depend on its hunger. The external orifices look like so many shot-holes, but the channels are anything but straight. From a long examination of the subject I am inclined to think that all the damage was done before the library came to this site in the spring of 1833. At all events, there is no reason to suppose that any of the mischief has been caused during the last fifty years. Perhaps the furnace-heat dries up the moisture which is a requisite condition for the life and propagation of the little animal.

Nearly two years ago I received a parcel of books from Florida, of which some were infested with vermin, and more or less perforated in the manner I have described. It occurred to me that they would make a good breeding farm and experiment station for learning the habits of the insect ; and I accordingly sent several of the volumes to my friend Mr. Samuel Garman, who is connected with the Museum of Comparative Zoology at Cambridge, for his care and observation. From him I learn that the principal offender is an animal known popularly as the Buffalo Bug, though he is helped in his work by kindred spirits, not allied to him according to the rules of natural history. Mr. Garman's letter gives the result of his

labours so fully as to leave nothing to be desired, and is as follows :—

"Museum of Comparative Zoology, Cambridge, Mass., *February* 7, 1893.

"Dr. Samuel A. Green, Boston, Mass.

"Sir,—The infested books sent for examination to this Museum, through the kindness of Mr. George E. Littlefield, were received July 15, 1891. They were inspected, and, containing individuals of a couple of species of living insects, were at once enclosed in glass for further developments. A year afterward live specimens of both kinds were still at work. Besides those that reached us alive, a third species had left traces of former presence in a number of empty egg-cases.

"Five of the volumes were bound in cloth. On these the principal damage appeared at the edges, which were eaten away and disfigured by large burrows extending inward. Two volumes were bound in leather. The edges of these were not so much disturbed ; but numerous perforations, somewhat like shot-holes externally, passed through the leather, enlarging and ramifying in the interior. As if made by smaller insects, the sides of these holes were neater and cleaner cuttings than those in the burrows on the edges of the other volumes.

"The insects were all identified as well known enemies of libraries, cabinets, and wardrobes. One of them is a species of what are commonly designated 'fish bugs,' 'silver fish,' 'bristle tails,' &c. By entomologists they are called *Lepisma ;* the species in

hand is probably *Lepisma saccharina*. It is a small, elongate, silvery, very active creature, frequently discovered under objects, or between the leaves of books, whence it escapes by its extraordinary quickness of movement. Paste and the sizing or enamel of some kinds of paper are very attractive to it. In some cases it eats off the entire surface of the sheet, including the ink, without making perforations ; in others the leaves are completely destroyed. The last specimen of this insect in these books was killed February 5, 1893, which proves the species to be sufficiently at home in this latitude.

" The second of the three is one of the ' Buffalo Bugs,' or ' Carpet Bugs,' so called ; not really bugs, but beetles. The species before us is the *Anthrenus varius* of scientists, very common in Boston and Cambridge, as in other portions of the temperate regions and the tropics. Very likely the ' shot-holes ' in the leather-bound volumes are of its making, though it may have been aided in the deeper and larger chambers by one or both of the others. The damage done by this insect in the house, museum, and library is too well known to call for further comment. Living individuals were taken from the books nearly a year after they were isolated.

" The third species had disappeared before the arrival of the books, leaving only its burrows, excrement, and empty egg-cases, which, however, leave no doubt of the identity of the animal with one of the cockroaches, possibly the species *Blatta Australasiæ*. The cases agree in size with those of *Blatta Americana*, but have thirteen impressions on each side, as if the number of eggs were twenty-six. The ravages of the

cockroaches are greatest in the tropics, but some of the species range through the temperate zones and even northward. An extract from Westwood and Drury will serve to indicate the character of their work :—

" ' They devour all kinds of victuals, dressed and undressed, and damage all sorts of clothing, leather, books, paper, &c., which, if they do not destroy, at least they soil, as they frequently deposit a drop of their excrement where they settle. They swarm by myriads in old houses, making every part filthy beyond description. They have also the power of making a noise like a sharp knocking with the knuckle upon the wainscotting, *Blatta gigantea* being thence known to the West Indies by the name of drummer ; and this they keep up, replying to each other, throughout the night. Moreover, they attack sleeping persons, and will even eat the extremities of the dead.'

" This quotation makes it appear that authors as well as books are endangered by this outlaw. With energies exclusively turned against properly selected examples of both, what a world of good it might do mankind ! The discrimination lacking, the insect must be treated as a common enemy. As a bane for ' silver fish ' and cockroaches, pyrethrum insect powder is said to be effectual. For a number of years I have used, on lepisma and roach, a mixture containing phosphorus, ' The Infallible Water Bug and Roach Exterminator,' made by Barnard & Co., 7 Temple Place, Boston, and, without other interest in advertising the compound, have found it entirely satisfactory in its effects. Bisulphide carbon, evaporated in closed boxes or cases containing the infested articles,

is used to do away with the 'Buffalo Bugs.'—Very respectfully yours,

"SAMUEL GARMAN."

I can remember that many years ago there was to be seen in the bookshop of John Penington, Philadelphia, a book-worm preserved in spirits in a vial. The manner in which this species of teredo penetrates wood and leather as well as paper is not the least curious of its habits.

The great amount of injury inflicted by boring-insects in books, wood, and all weak substances is sufficient reason for giving so much space to this subject. From a ship to a manuscript, nothing is safe from them.

PAPIER-MÂCHÉ

REPAIRING TOYS — MAKING GROUNDS FOR PICTURES AND WALLS—CARTON-CUIR AND CARTON-PIERRE

Soft paper, when mixed with water, gum, or, better still, with flour-paste, forms a substance which can be moulded to any form, and which, when dry, will be as hard as cardboard. Its hardness and durability may be increased by mingling with it many substances.

Combined with soft leather in small fragments or with the dust of leather, it forms what the French call *carton-cuir*. In this, or even in its natural state—that is, paper and paste—*papier-mâché*, as it is termed, can under pressure be made as hard as any wood. I have seen all kinds of articles of furniture made from it. In America there are manufactories in which pails or buckets, tubs, firkins, and even durable boats, are thus manufactured. There is in Bergen, Norway, a church built entirely of it mixed with lime. For certain kinds of mending it is very valuable.

Though not so plastic as clay, *papier-mâché* can, with a little practice, be moulded into any form. It consists simply of pasting piece on to piece, pressing it meantime as much as possible with the fingers or a

wooden implement like a pestle. The pressure should be applied as it gradually dries. Any one can thus make very hard cardboard with a bread-roller on a board.

If you have the cardboard cover of a book badly damaged, with even a portion gone, it can be restored by using *papier-mâché* in which a solution of glue or gum has been infused. Glue it specially at the edges. For such repairing take paper-dust or pulp, combined with gum-arabic in alum-water solution, or simply the gum. This is easily moulded and smoothed into any cracks or torn places.

If *parchment* be torn away it is easily replaced. Cut a piece to replace the missing portion, dampen it and the edge which it is to join till quite soft, then glue the two together, using pressure. I have just effected this myself with a cover of which half was gone, and the mending is hardly visible. Use the broad knife freely to press down the edges.

By combination with a mixture of nitric or sulphuric acid and water, *soft* paper becomes parchment-like and very hard. This requires careful experimenting, for its success depends on the quality of the acid and the texture of the paper. Very remarkable results have been obtained from this, such as material resembling ivory, horn, and tortoise-shell, in large blocks.

Waste-paper is so common and cheap that *papier-mâché* can always be made anywhere. It is well adapted to close cracks in wood, walls, or elsewhere ; and for those who wish for an employment or amusement, it affords endless facilities. One of these is the mending or making of toys.

A common mask is made as follows. On a face carved in wood and oiled there is spread common coarse soft paper wetted, which is carefully pressed down, and more paper and paste added, till it is of the requisite thickness. It is then, when rather dry, taken off and left to dry perfectly. It is then painted and varnished. Should a mask be broken, wet it, paste glue-paper over it, and paint it again.

Papier-mâché is popularly synonymous with that which is trashy and sham in art, simply because its capacities and applications are not known. Thus leather-work was long despised as only affording imitations of carved wood. But in the hands of a true artist—that is, of an *original designer*, who applies, and not a mere artisan, who imitates or copies—*papier-mâché* is as much a subject for art as any other material. It can be used in many ways, more or less allied to mending, as are all arts. Thus paper in fine powder, or reduced to a fine paste—or pulp—can be, with a little practice, mixed with gum and *painted* with a brush on a surface so as to produce relief. A very little elevation or depression thus serves to produce grounds which may serve to give light or shadow to pictures. Thus pastel painting or crayon in colours rubbed in, which has always been, even in the most vigorous hands, a weak or "softly sweet" art, may be made very vigorous by firmly relieving and roughening the ground; for, as the great American painter, Allston, often strengthened his colours by mixing sand with them, so pastel painting which lacks "sand" can have it supplied by mixing it with the gum for the ground.

To understand this process more clearly, let it be

observed that, as the illuminators of mediæval manuscripts gave relief and the appearance of solidity to gold by making a raised surface with a powder of *gesso* (plaster of Paris) and clay and gum, so this principle can be carried out to a far greater extent by giving relief to a ground. Here those of limited views, who never get beyond the merely artisan stage of art, will at once decry this as shamming, and as imitating effect by the aid of modelling, and not being true art, quite forgetting that all is true to genius, and everything more or less sham in the mere imitation.

Having a surface, either panel or Bristol board, which latter had better be pasted to a panel or good thick solid cardboard, begin by taking a little gum or glue in tolerably fluid solution on the point of a brush, and incorporating with it the paper pulp or cloth-dust to a very soft paste, with which paint what is to be in relief. The same effect is produced in oil by using a heavier, thicker kind of paint. That is all the difference, one being as legitimate as the other. By intermixing chalk or sand or clay, and by using glass-paper where the crayon, &c., refuse to take easily, the relief adapts itself to every substance. In this, as in every process known, the artist must at first experiment a little, according to his materials.

Solid sheets of fine hard paper, with strong paste between, when passed between rollers form a kind of *papier-mâché* which is as hard as wood, fire-proof, and, what is most singular, more durable than iron. Wheels for railway carriages are often made of it, and they never warp under the action of heat or cold, neither do they crack nor bend. You can make this

cardboard for yourself of very good quality by this process :—Take a sheet of writing-paper—the better the quality the better the result will be—cover it with good flour-paste in which there is a little alum and glue and a few drops of oil of cloves, which latter will prevent paste from turning or souring. Then lay on this another sheet, apply another coat of paste, and when it is a little dry or past the softer stage, yet while still capable of adhesion, lay the sheets on a hard, smooth slab or table, and pass a roller over them, at first gently, but eventually frequently, and with force. Add as many sheets as necessary for the thickness required. It will be understood that if the surface on which this sheet is formed were an intaglio-cut die or mould, the cardboard when taken up would present a bas-relief of it as hard as any wood, and the whole would form a panel which could be used for the side of a box or to be set in a cabinet. If made of good paper and firmly rolled, this panel will be in every respect equal to wood for all decorative purposes.

As anybody who can carve wood at all can cut moulds, and as a wooden mould, if kept well oiled (or otherwise secured from yielding to moisture), will serve for *papier-mâché* and leather or wood-paste casting, it is remarkable that such work is so very little practised by the students of the minor arts. That such panels can be very easily and rapidly made I know by experience ; that the materials for the work are cheap speaks for itself ; and, finally, that beautiful panels for cabinets and doors, whether made of carved wood, stamped leather, or *papier-mâché*, bring a very good price will also be most apparent to any-

body who will go to a fashionable cabinetmaker and order them. Thus we will say that a small plain cabinet costs £5. Put into it six panels, really costing about 6d. each to mould, and the price will be £10. Such pressed panels are admirably adapted for binding books, as, when properly made and dried, they cannot warp or bend. If covered with relief they may be made very beautiful. Simply blackened or browned, then rubbed with oil, varnished with SOEHNÉE, No. 3, and rubbed by hand, they are as beautiful as polished wood or leather.

Papier-mâché, pulp, or paper powder can be combined with caoutchouc or indiarubber, which latter can be itself dissolved in benzine, camphine, sulphuric ether, and other solvent mediums, so as to form a paste which becomes like indiarubber when dry or as it hardens. Mixed with sulphur this forms vulcanite. Or it may be combined with white colouring matter of almost any kind. This can be applied to mending the broken noses of dolls, or any other wounds which these pretty semblances of humanity often receive, their beauty being unfortunately generally more shortlived than that of their prototypes. The final finish of such reparation is a coat of paint. In many cases this is better when rubbed on with the finger than when directly painted. The reader who shall have studied this work will find no difficulty in restoring any toy.

I may, however, here remark that "no solution of indiarubber can be well moulded without intimate intermixture of sulphur, aided by heat and pressure. This is a difficult process, and the amateur would do well, therefore, to purchase rubber composition, which

he may do at any large shop in which rubber goods are made as a specialty" (*Work*, May 21, 1892).

It is easy to make any article of *papier-mâché* if the mere beginning of a form has once been shaped ; because, after that is set, all that we have to do is to gradually paste one piece of paper on, here and there, till it is finished. This beginning is very easy if we have an object on which to begin. Thus take a vase or cup. Oil this, and then lay on and all around it soft, damp paper. Newspaper will do—a *soft*, white printing paper. Then, with a broad brush, lay on paste, and apply a second coat of paper. Press it meanwhile as hard as you can. Continue this till the *papier-mâché* is thick enough. When dry, take a penknife and cut a line through from top to bottom. Scale it off, and reunite the edges with strong glue ; then paste over the line of junction a strip of paper. Then you will have a cup.

If it be rough, cut it smooth and use glass-paper. When finished it may be painted or covered with wet leather, which can be worked into relief. Or it may be made to look like ivory by the process elsewhere described. Paper may in this process be combined with soft leather rags ; as, for instance, pieces of old gloves out of which the thread has been taken, old chamois, bookbinders' clippings, or the like. This forms effectively leather.

Carton-pierre, or stone-paper, is a very useful composition, which is very fully described by George Parland in *Work*, July 2, 1893. It consists of paper scraps, in the proportion of an ordinary washing

boiler or copper one-half full of boiling water and about one-half paper waste. Add two pounds of best flour-paste; also, in a separate vessel, a quart of water, into which sprinkle a handful of fine plaster of Paris. Let it stand ten minutes before mixing it. "When the paper in the copper has become a fine pulp add the flour-paste, keeping the whole well stirred. Fifteen minutes after add the plaster, and a few minutes later take out the fire from under the boiler. Have ready three pails of fine ground whiting; pour in one pail of whiting and stir up well, adding more whiting till the stick used to stir will stand of itself in the mixture. Let it cool, and it will be ready for use.

"Some firms," writes Mr. PARLAND, "add powdered alum in the boiling process, others add one pint of boiled linseed-oil; but if made according to the previous directions, an excellent *carton-pierre* will result, which gives very fine impressions from moulds. If it be cast in a plaster mould, the latter should have two or three coats of shellac varnish, and then be well oiled. . . . In using the *carton*, sprinkle some fine plaster of Paris on a bench, and taking a lump of the newly made *carton*, mix it well with dry plaster, adding more plaster, as bakers would add flour to their dough. Having worked it well in this way until it will not stick to the fingers, with clean hands roll pieces very smooth in the palms, or on a smooth level board, and press each roll into the cavities and hollows of the mould, *often wetting the edges of the carton* in the mould before adding a fresh piece to it. The casts must not be more than from an eighth to a quarter of an inch in thickness, except at the outside edges

of the mould. . . . The casts must stand about twenty-four hours, and then be baked in not more than 100° heat."

The reader who is specially interested in *papier-mâché* will find a series of articles on the subject in *Work*, Nos. 3, 6, 12, 17, 22, 25.

Pipeclay, to which calcined magnesia, whiting, or baryta may be added or omitted according to the body required, may be combined with *papier-mâché* and gluten, such as gum-arabic or dextrine or flour-paste, which will form under pressure, or even by hand-rolling, a very hard and finely grained substance, which is specially adapted to painting pictures. Plates or *tavole* are sold very cheaply in Florence of *papier-mâché*, which are as hard, heavy, and glossy as ebony. It is not generally realised that an expensive hydraulic-press or steam-engine is not needed by the amateur to harden *papier-mâché*. A common bread-roller, passed many times over the material, will work it "down and in," quite as well as direct pressure, and very often much better.

Papier-mâché mixed and macerated with indiarubber or gutta-percha and benzole (*vide* Indiarubber) forms in many cases a very good substitute for leather. It can also be combined with *flexible* varnish to make leather. Very valuable soles can be made, or broken ones repaired, by taking card or pasteboard and soaking it in a hot solution of indiarubber. These waterproofed soles, whether of cardboard or leather, are easily prepared, as easily applied and renewed, and they will keep the true sole from wearing out forever, if renewed.

Singular as it seems, there are not many persons

who are familiar with the properties or texture of so familiar a substance as paper. We know that if wetted it grows soft, but still remains, as it were, knotty, and that when chewed it does not properly dissolve. Yet if the reader will take a piece of thoroughly wetted paper, and knead or macerate it with a knife for some time with gum in solution, he will find it gradually becomes a soft paste, as flexible and as capable of moulding as putty or clay. This is not the same as *papier-mâché*, which consists of paper merely wet or mixed and boiled with paste, and contains fibre and knottiness. The finely macerated paper, combined with an adhesive, is ductile, impressionable, sets well, and readily receives pressure on rolling, under which it becomes extremely hard. Paper thus *completely softened* is readily made into sheets, and may be easily applied not only to fill up worm-holes in leaves and completely torn-away corners, &c., but is very useful for cracks and cavities in wood and other substances. It may be made up with any gums, such as gum-arabic, dextrine, fish-glue, and also with caseine, gutta-percha, varnish, and most of the substances used in cements. Paper when thus softened and mixed with, *e.g.*, fine glue and glycerine, or with flour-paste, can be moulded and applied in ornamental forms to any surface.

There is this great difference between simply *wet* paper, however wet it may be, and that which is completely softened by maceration. The former is always lumpy, the latter passes under the blade of a knife like soft clay or putty. When made up with gum, glue, and glycerine, or strong paste, it is, when dry, like light wood, but less brittle. Kneaded with Indiarub-

ber solution and glue, it becomes like leather, and can be used in several varieties of repairs. Rolled into sheets, this composition makes very good and cheap artificial leather for hangings. To manufacture these, spread the composition with a broad brush or dabber on a slate or marble table, and when rather dry pass over it a wooden roller. Some practice is needed not to roll it when too soft. If intaglio patterns are cut in the roller, the sheets will give them in relief. It is worth noting here that a great many pieces of old hangings sold as leather are really only made of *papier-mâché*, or *carton-cuir*, and glue. These hangings, whether of leather or counterfeited, can be often bought in a damaged condition very cheaply, and can be easily restored with this composition, to great profit. When mixed with white lead, or oil paint and glue, soft paper becomes harder and firmer, and under pressure is as hard and heavy as any wood. White paper with holly wood or white larch or lime-tree wood in powder, and white gelatine—better if bone or ivory dust be added, with a little Naples yellow (oil)—forms a beautiful cement.

It will be seen by what I have written that cavities, holes, cracks, and defects in most substances, including wood and leather, can be perfectly remedied with paper in combination with glue, gum, or other substances ; and as it is always to be obtained, a knowledge of its nature and applications cannot fail to be of value to all menders and restorers.

Papier-mâché, like all substantial or putty-like cements, involves moulding or casting. This subject is exhaustively treated in the *Vollständige Anleitung zum Formen und Giessen*, by Eduard Uhlenhuth ;

Vienna, A. Hartleben, price 3s. On the subject of paper consult the *Handbuch der praktischen Papier-Fabrikation*, by Dr. Stanislaus Mierzinski, three volumes, which is not only the latest, but by far the most comprehensive, work on the subject with which I am acquainted. And here I may observe in this connection that if my references have been chiefly to German works, it is because, in the minor technical applications of chemistry to the arts, and in preparing intelligible practical treatises on such subjects, the Germans have been, especially of late, by far the first nation in Europe.

I may mention that since writing the foregoing passages I purchased, for a mere trifle, in Florence two carved heads of the fourteenth century in walnut wood. They had suffered very much from time and wanton abuse, their noses having been hacked off. I made a mixture of soft paper-paste and gum-arabic, working the two thoroughly in together with a knife-blade till the composition was as soft as butter. This thorough maceration is essential to produce a durable body. With this I filled up the holes, made new noses, and painted the whole with Vandyke brown, or brown-black. In a few minutes the restoration was complete, and the heads which had cost one franc each are now worth at least thirty francs. I should say that the portions restored are as hard as the original wood.

It is not always an easy matter to reduce paper to a perfectly soft paste, such as is called in French *papier-pourri*. A small quantity can be mashed with a knife-blade and flour-paste or gum. A large quantity is prepared as follows :—

Take clippings of paper and leave them a long time in water, which must be occasionally changed. When quite dissolved or soft, bray the paper in a mortar, and finally boil in very hot water. To give it consistency, add flour-paste or gum. This makes a very fine cement, which will receive the most delicate impression. It is invaluable for all kinds of dry mending.

As I have shown, it can be applied to make or mend defective leaves of books, to fill up worm-holes in leaves, to repair drawings and pictures on wood or canvas, and when mixed with any gum which sets hard, to restore, add to, fill, or imitate woodwork. Under pressure and combined with different powders it becomes as hard as ebony and fire-proof. Its extraordinary value and general utility are as yet very far from being much known.

MENDING STONE-WORK

MOSAICS—CERESA-WORK—PORCELAIN OR CROCKERY MOSAIC

MENDING or repairing *stone*, involving its imitations, is a widely extended branch of technical science, and one which has of late years called forth much invention. The most widely spread and ancient means of uniting and repairing this material is mortar, or the mixture of burned and then slacked lime with water. Lime is made most commonly from limestone or marble. It improves in quality when carbonate of lime in organic formation, such as sea-shells, is used; and there are degrees of excellence in these, from common oyster-shells to others of a finer kind, such as those with which the brilliantly white and hard *chunam* of India is made. In certain places mortar, when well made, becomes with age as hard as flint. In American towns, where anthracite coal is burned, it rots away in chimneys under the influence of sulphurous acid with great rapidity. In the Pacific Islands, where lime is made from delicate small sea-shells or coral, and mortar is like a paint or enamel, a missionary has recorded that, when he taught the natives how to make it, they whitewashed everything, even to the children, who thus became white people.

The misapplied word *mastic*, which suggests a gum, refers to certain modifications of mortar into which *oil* enters; also the oxides of lead or zinc. "Oil forms with these an insoluble soap, which includes or binds the other materials, forming, after one month's drying, a very hard substance," which some say is as hard as stone, but which depends entirely on the quality and combination; for I have seen so-called *mastic* applied to coating cheaply built houses, which cracked or crumbled away like mere plaster of Paris.

To thoroughly amalgamate mastics, it is usual to put their ingredients into casks which are two-thirds filled, and then revolved by machinery. The oil is then added. At least two days are required for the process. The following recipes for mastics are among the best, having been approved by LEHNER. It may here be remarked, once for all, not only as regards mastics, but all recipes in this work, that unless the materials indicated are of the very best quality, and the processes be most thoroughly carried out, the experimenter cannot expect complete success. More than this, the experimenter must not be satisfied with a single trial. If every recipe could be at once executed by every cook, we should find the most exquisite cookery on every table in Europe. I once published the correct recipe for making objects of a peculiar kind of *papier-mâché* hardened. It was very easy to make. I had seen specimens of the ware, and I received the recipe from the inventor. Moreover, a great deal of money had been made by it. However, soon after I had published it I received an indignant letter from the head of a large manufacturing house,

stating that they had tried my recipe and utterly failed !

FRENCH MASTIC :—

Quartz or flint sand, parts	300
Powdered quicklime, ,,	100
Litharge, ,,	50
Linseed-oil, ,,	35

PAGET'S MASTIC :—

Flint sand	315
Washed chalk	105
White lead	25
Minium	10
Sugar of lead in solution	45
Linseed-oil	35

The paste or "dough" thus formed should be ground with horizontal rollers in a mill, such as is used for chocolate, until all the ingredients are *very* thoroughly amalgamated.

A VERY GOOD CEMENT FOR MENDING, especially where the objects are exposed to water, whether they be of stone or earthenware, is made as follows :—

Powdered glass	40
Washed litharge	40
Linseed-oil varnish	20

The powdered glass is prepared by heating glass red-hot, casting it into water, grinding and sifting it. This powder is saturated with the linseed-oil varnish, and heated in a kettle. This cement sets hard in three days. LEHNER observes that glass-powder serves in such recipes to resist the action of acids, &c.,

since it forms in combination on the surface a glaze of great hardness ; that is, the glass and lead form a chemical combination. Pulverised calcined glass therefore acts not as an "indifferent" but as a chemical ingredient.

Caseine, or Cheese, forms the basis of several recipes for mending stone, as when there are holes in a block or the mortar has given way. To prepare it for use (Lehner), we let milk stand in a cool place, skimming away with the utmost care all the cream. Place this on a filter, and pour on it rain-water till it is purified from every trace of lactic acid ; then tie it in a cloth, boil it in water, and spread it on blotting-paper in a warm place, when it will be a horn-like substance. This will keep for a long time. To prepare it for use, rub it in a saucer with water.

To mend stone make the following :—

Caseine	12
Slacked lime	50
Fine sand	50

Another recipe :—

Boil new cheese in water till it draws out in threads, stirring in slacked lime and sifted wood-ashes in the following proportions :—

Cheese	100
Water	200
Slacked lime	25
Wood-ashes	20

This may also be used to close cavities in trees or in wood.

A cheese cement for stone, and for many other

purposes, is made as follows. It may be kept for a long time, and is very durable (LEHNER) :—

Caseine	200
Calcined lime	40
Camphor	1

This must be closely incorporated and kept well corked. When it is to be used mix it with water, and apply at once.

The following cement was used by the Romans especially in setting mosaics. It becomes as hard as marble, and sets with great rapidity :—To one quart of milk add the white of five eggs, and stir in powdered quicklime till a paste is formed. This composition may be used to repair or make *scagliola*, which is fragments of marble or stone embedded in a hard mass. When it sets, polish the surface with rasps, and rub down with a rough stone, and finally polish with marble dust, and then emery or tripoli. Beautiful slabs for tables, columns, floors, and walls can thus be made. It is valuable for repairing.

CERESA is allied to this. We make a basis of this or any other cement which will *hold firmly*, and press into the surface powdered glass, which may be fine or of any degree of coarseness. Coarse grains shine most brilliantly ; fine powder is best adapted to delicate shading. The effect is best when mosaic stones and gold cubes are sparingly introduced. To make the gold cubes, take two small panes of window glass, cover one side of each with varnish or mastic cement, lay between them gold-leaf, and join them. Very beautiful pictures can be made in this manner. Nor is it at all necessary that they should be finely exe-

cuted for ordinary decoration. All that is needed for this beautiful and little-known art is the cement, a quantity of glass or stone of different colours, and a mortar and pestle. The mosaic cubes, with those of gold, can be bought in London.

Allied to this is an art which I believe I can claim to have invented. It consists of breaking waste china-ware, crockery, or fictile ware into small squares or triangles, and setting them as mosaic in cement. The advantage of it is the cheapness of the material, and the infinite number of shades of colour which can be selected for it. Its disadvantage is, that it will not wear as a pavement, but it is perfectly adapted to walls.

A STRONG, COARSE CEMENT FOR BRICK OR STONE WORK in building is made as follows :—

Slacked lime	40
Brick-dust	10
Iron filings	10
Ox-blood	8
Water	8

The blood is stirred as it comes from the slaughtered beast with a broom for ten minutes to break the fibre. It should then be mixed with the water and kneaded with the powder. Glue may be substituted for the blood. This cement, if properly made, sets very hard and adhesively.

FOR TILES, BRICKS, OR COMPOSITION :—

Slacked lime	100
Sifted stone-coal ashes . . .	50
Stirred ox-blood	15

It may be observed that many of the cheaper cements can be employed to form large bricks by combination with broken stone or rubble, gravel, pebbles, brickbats, &c. Another method, called Concrete, is to make cases of boards, and to form a solid wall by pouring in the mixture, or ramming it down, according to its hardness. Thus a house is made entirely in one piece ; but its excellence depends entirely on the quality of the cement employed, and on the care taken in building. Simple lime mortar, if not of a superior quality, hastily formed, as I have seen, is very apt to crack and break off. Where hydraulic cement is cheap and good, houses can be built as firm as granite. A good and strong cement of this kind can be made as follows :—

Burned lime	10
Caseine	12
Hydraulic cement	30

The proportions may be very much varied in such cements according to their price, but generally with a satisfactory result.

Fractures or discolorations in marble, as in statuary, are so perfectly repaired in Florence that the juncture is not perceptible. Even dark spots are drilled out. The process is to drill a round concave hole, and cut the piece to be inserted so as to exactly fit as a convex plug. It is then fastened in with transparent mastic or other clear cement. It will be seen, on due consideration, that this is extremely ingenious, because by it alone can a perfectly tight fit be secured. By turning the plug in the hollow it speedily grinds itself

into an accurate plug ; so when the cement is applied it can be reduced to a minimum—in fact, by this means the line of junction is reduced to its finest limit.

Where a very strong cement is needed for stone-work, it can be prepared by mixing a fine cement powder —*e.g.*, Portland cement—with liquid silicate of soda. As it dries almost at once, it must be promptly applied. It is particularly well adapted for building under water, since it then becomes extremely hard. Before applying it smear the stone with pure silicate.

The following is highly commended by LEHNER :—

Mending statues of gypsum or plaster of Paris is allied to stone-work. The broken edges are washed with water till no more is absorbed and the surface remains wet. Then stir fresh calcined white plaster of Paris with much water to a thin paste, and continue to stir this till it is cold. Then rapidly paint this paste on the broken edges, continuing to press the two together till they set hard.

It is, says LEHNER, a peculiarity of gypsum that when mixed with *alum* dissolved in water it takes a much longer time to harden, but is very much harder in the end. Thus, if we let the powdered gypsum lie for twenty-four hours in alum-water, dry it, and then calcine it again, the powder when mixed with water sets to a stone as hard as marble.

Plaster of Paris and alum, combined with the fine powder of calcined glass, form a very hard and durable cement, of very general utility in all mending of stone-work.

For an exhaustive work on the subject of not only

mending stone-work, but also of making artificial stone and many cements, as well as combining and adapting to use paper, cellulose, sawdust and shavings, gypsum, chalk, glue, &c., including not only ancient but also the most recent recipes, consult *Die Fabrikation künstlicher plastischer Massen*, by Johannes Hofer ; Leipzig, A. Hartleben, price 4s.

REPAIRING IVORY

Works of art in carved ivory or bone are very valuable when perfect, yet when broken or defective they may very often be purchased for a trifle. Yet the process of mending them or restoring the missing portions is not difficult.

The first thing to consider is the colour. When old ivory has only acquired a delicate hue, as of Naples yellow, this adds to its attractiveness ; nor are the brownish shadows and marks which gather in the angles of the reliefs repulsive. These may be left untouched, and even imitated. But a great deal of old ivory becomes of blackish bistre, or of a dirty, spotted brown or neutral tint, which has nothing in common with artistic effect, and suggests, like old slums in cities, more that is repulsive than picturesque. To clean such pieces, dissolve rock-alum in rain-water till it is white or forms a full saturation. Boil this, and keep the ivory in the boiling solution for about an hour, taking it out from time to time and cleaning it with a soft brush. Then let t dry in a damp linen or muslin rag ; it will then be cleaned.

Ivory is often bleached by the simple process of damping, or wiping it with water and then exposing it to the rays of the sun ; which must, however, be

frequently repeated. According to LEHNER, the only perfect and certain process by which any ivory can be cleaned is to steep the article for some time in ether or benzole, in order to extract any fatty matter, then to wash it in water, and finally keep it in super-oxide of hydrogen (*Wasserstoff*, *super-oxide*) till it is bleached, after which wash again in water.

TO SUPPLY MISSING PORTIONS.—Take ivory-dust, such as can be bought of every ivory-turner, sift it to an impalpable powder, or else levigate or grind it down under water as fine as flour in a mortar. Then combine this with gum arabic, in alum solution, or the silicate of potash. Egg-shells, levigated, may be substituted for the ivory-dust, and are even less likely to turn grey ; and very fine white glue or gelatine of the clearest kind may be substituted for the gum-arabic.

LOUIS EDGAR ANDÉS, in his able work on Ivory, Horn, Mother-of-Pearl, and Tortoise-shell, explains a process much like that already described. According to him, take finely powdered bone (or ivory-dust), combine it with white of eggs, and the result will be an intensely hard substance, which can be turned or carved like ivory. To perfect this the mass should be subjected to a heat of from 50° to 60° centigrade, and then to strong pressure. Gelatine or best glue, with glycerine, is quite as good as the white of eggs, and it may to advantage be combined with the latter. Having very thoroughly mixed the composition, take the broken ivory article, repair the missing portions, and fill the cavities with the paste. Though not equal to celluloid as an imitation of new and fresh ivory, this cement is very much like old bone and

ivory, and *after a little experimenting* the artistic amateur may succeed in so blending the *binder* or adhesive with the dust as to take casts which are almost perfect imitations of the originals. But let it be observed in this, as in everything, one must not expect perfect success at a first trial, as too many do.

When the paste is dry, smooth the surface with a sharp cutter, so as to remove any small projections, and then polish it, first with fine emery or tripoli, then with a burnisher, finally by hand.

If you have, for example, an old flat plate of ivory, like one of the fourteenth century now before me, which I bought for a mere trifle because it was broken, lay it in an exactly fitting box—a strip of tin in a square will answer—and fill in the vacancy. The missing ornament on the upper side can be carved, or even supplied from a hardened stamp or mould of rolled soft bread-crumb. This bread-crumb can be made very hard by admixture with a very little nitric acid and water. Imitation meerschaum pipes, which are rather like ivory or bone, are made from this composition by pressure.

I may here mention that this ivory or bone cement, which is little known, is admirably adapted to repair broken inlaying. There was in Florence, in the sixteenth century, an extensive manufacture of delicate bas-reliefs for small caskets from *lime and rice*, which greatly resembled bone or ivory. It was extremely durable, probably from being extremely well worked. Specimens of it bring a high price.

A very slight infusion of Naples yellow, to which a suspicion of brown, reduced in Chinese white, has been added, gives to the paste an old-ivory colour.

The corners and outlines may be shaded in Vandyke brown.

Before attempting to glue or mastic fractured ivories, they should always be washed in the alum solution, else they will often refuse to adhere.

When there is a little addition of whiting and a little oil, very well worked into the ivory paste, and it is allowed to dry thoroughly, it may be cut or carved into any shape.

Ivory or bone when very old becomes brittle or crumbling and falls to powder, because certain organic substances dry out of it, leaving chiefly lime as their residue. When the ivories from Nineveh were brought to the British Museum the celebrated Sir Joseph Hooker suggested that they should be steeped in gelatine. This effected a perfect restoration. When a case occurs in which an ivory article, a bone, or skull is so fragile that it will not bear the slightest touch without falling to dust, it may often be saved by gently *spraying* on it water in which gelatine or glue has been dissolved. As the glue may be made by boiling old gloves, and as a spray can be easily improvised, it will be seen that excavators and openers of ancient tombs might by this means save thousands of curious relics which are allowed to perish. As it is certainly a species of mending or of restoration, it is in place in this work. This is especially to be desired as to skulls of the earliest ages, which are of inestimable value, of which we have so very few, and of which thousands have perished which might have been preserved in the manner which I have indicated.

Sprays for spreading perfume or medicated liquids,

which can be adapted to thin liquid glue, may be had of all chemists. But we can effect the purpose better by taking a tooth-brush, or any brush of the kind, wetting, and then drawing it over a dull edge of a knife or a strip of tin. According to J. C. Wiegleb, a Frenchman in his time received a very large pension for this invention, which was applied to spraying pastels. The Romans made a spray, very imperfectly, by suddenly squeezing or throwing liquids from a sponge.

Ivory handles to knives and forks, when loose, can be best reset by first pouring in a little strong vinegar. When dry use acidulated glue. A common recipe for this purpose is the following :—

Resin (colophonium) . . .	20 parts
Sulphur	5 ,,
Iron filings	8 ,,

Heat, and use while soft.

In repairing ivory it is often necessary to stain it of different colours. Most of the old works on recipes contain directions for this. In that of Ris Paquot they are given as follows :—

First prepare a mixture of copper filings, rock-alum, and Roman vitriol. Boil it, let it be for six days, then add a little rock-alum. The piece of ivory to be dyed is kept in this solution for half an-hour. *To dye Red.*—Boil logwood chips or cochineal in water ; when hot add lead dross (*cendre gravelée*) about 25 grammes, keep it in the fire till the colour has taken, then add rock-alum. This is strained through linen, and the ivory to be dyed is put into this liquor. *Green.*—Take one quart of lye made from vine-ashes

(*cendre de sarment*), 7 grammes of powdered verdigris, a handful of common salt, with a little alum. Boil it to one-half ; as soon as it is taken from the fire place the ivory in it, and leave it till properly coloured. *Blue.*—Dissolve indigo and potash in water, and then mix this with a quart of vine-ash lye. *Black.*—Boil the ivory in the following composition :—Vinegar, 500 grammes ; gall-nuts pulverised, 12 grammes ; nut-shells, 12 grammes. Boil down to one-half. These are all very strong dyes, which may be used for other substances.

"Ivory can be softened and made almost plastic by soaking in phosphoric acid. When washed with water, pressed, and dried, it will regain its former consistency." Ivory-dust thus treated can be really rendered plastic. The process requires care.

In the *Magia Naturalis* of HILDEBRAND, a work of the sixteenth century, we are told that ivory can be imitated or repaired with a cement made of powdered egg-shells, gum-arabic in solution, and the white of eggs. Dry it in the sun.

Allied to ivory is Horn. Deer-horn was frequently used as a material whence to make a substance which was moulded into many forms. For this purpose the hardest part of the horns was selected and filed or powdered, and then boiled in strong potash lye. Thus it became a paste, which was promptly pressed into moulds. When dry the figures were carefully polished. Ox-horn can be treated in the same manner. When cracked, carved horns or powder-flasks can be mended with this paste ; also with mastic and

whiting. Horn in a soft state is easily coloured by mixing with it any dye.[1]

It has been recently complained in a leading review, in an article on sales of ancient works of art, that imitations of antique works of ivory are now carried to such perfection that even the learned in such matters have been deceived. This is perfectly true, and therefore it is the greater pity that such imitation, which is not necessarily very expensive, cannot be extended to our great museums, the wealthiest of which thus far seldom get beyond rough, plain plaster-casts to make duplicates of ivory-work. The artists in imitation seem to be entirely in the employ of the people who deliberately sell counterfeits for genuine relics of antiquity. But, as Martin Luther or some one once remarked in reference to adapting hymns to popular airs, "There was no reason why the devil should keep all the good tunes to himself," so is there none why duplicates of thousands of exquisite works in ivory, bone, and horn should not be better known to the world. It is possible that, to the world at large, there is little *real* interest in such works; but interest will come in time with familiarity.

Apropos to ivory, or horn, there is a process of applying an imitation of them to any kind of surface, which is, when executed with skill, remarkably effective. It is chiefly executed in Vienna, where it is applied to leather, plaster of Paris, wood, and wall-paper. With variations, it is essentially as follows :—

[1] For fullest details as to the treatment of horn, the reader may consult *Die Verarbeitung des Hornes*, &c., by Louis E. Andés, in which he will also find full details as to dyeing ivory.

Cover the ground with flexible varnish, then paint over this with light Naples yellow, graduated as nicely to some old ivory model as possible. It is best not to have it all too uniformly of one tone, since old work often has its shades. The object here need not be to ape or copy old work, but to catch what is beautiful in it. Then fill in the outlines of the pattern, and the dots and irregularities near it, or anywhere, with brown more or less dark. For this, study old ivory. Then varnish with SOEHNÉE, No. 3. A great deal depends on the quality of this second coat. Finally rub down very thoroughly with chamois and hand, and repeat the process more than once if you want it very much like ivory. Very extraordinary and perfect imitations of ivory, bone, worn and glossy parchment and brown leather, wood, marble—in short, of any kind of work of art which has been rubbed and worn smooth by hand during centuries, can be made by this process of ivorying with alternate layers of varnish, colour, varnish, and so on.

When there is no relief the paint itself can be worked with wheel and tracer, and then repainted and varnished. This is a very beautiful art, specially applicable to book-covers, and often useful in repairing old work. I would here repeat what I said, that the object of imitating effects in old works of art, or in other kinds of art—which is so staunchly repudiated by mere artisans who themselves are generally only imitators of the designs of others—is not to make counterfeits, but to take from age or art beautiful effects, however produced, and apply them to work. Those who are too conscientious to execute stencilling on a wall, or to use moulds for leather-work, would

do well to first consider whether they *know enough* to design a really good or admirable stencil, or an excellent mould, for it is in the genius which originates and executes, not in the mere means, tools, and materials employed, that art consists. Art does not depend in the least on either making skill difficult or in rendering its methods easy; it displays skill, but scorns the Chinese standard of mere industry. An artist like ALBERT DÜRER would never have prided himself on only using certain tools as being "artistic;" he would, however, have made designs which would have forced originality and art into a photograph. There are marvellous effects of corrugation in ancient walls, plays of light and shade and colour and polish in rock and strand and heaps of ashes, which LEONARDO DA VINCI knew how to catch and transfer to different subjects, and at which perhaps the artisans of his time sneered as "not artistic."

Age, which gives a certain exquisite charm to wine and words of wisdom, has done the same to all material things, of which, indeed, it may be strangely said that wherever it does not destroy a charm it confers one, like moonlight, which renders nightly shadows more terrible or else more beautiful.

It is to be regretted that this principle, which is a very important one, is but little understood. The manufacturers of all decorative art work at present endeavour without exception to make everything staringly, cruelly brand new, or else a mere copy of old work. What they need is to draw, as REMBRANDT did, from age so much of its peculiar charm as is adaptable to modern work.

I have introduced these remarks because the mender

and restorer of old ivories and bookbindings and pictures, if he regards his occupation as an art—which it really is—is peculiarly adapted to fully appreciate them. Restoring, like copying, leads to creating new work. I think that any person of ordinary intelligence can, with zeal and application, learn to mend anything as described in this work, and from such mending it is much easier to learn to make works of minor art. "Short the step from senator to *podestá*—shorter the step from *podestá* to king."

A great merit and peculiarity of ivory, as of horn, is that it is tough and elastic, as well as of a beautiful transparent or diaphanous quality. These characteristics have, with the exception of its graining or texture, been well imitated thus far only in *celluloid*, which is unfortunately too expensive for very general use, and, what is worse, too liable to destruction. I, however, confidently anticipate that ere long some substance will be discovered much superior to celluloid as a substitute, and probably much cheaper and less perishable. To *celluloid* I may, however, add the sulphuretted preparations of caoutchouc and guttapercha, known as vulcanite or ebonite. These are indeed hard, tough, and elastic to perfection, but very dark and opaque.

Lehner, in his work *Die Imitationen*, observes that imitations of ivory must be varied to suit the colour and quality of originals. This requires a study, firstly, of the adhesive or glue which is to be used. This, when colourless, is known as French gelatine, and is very expensive. In lieu thereof the experimenter may take best white Salisbury glue or gum-arabic prepared with alum-water. Secondly, the

body, which may be of carbonate of magnesia, carbonate of lime, such as powdered marble, sulphuretted lime, or powdered gypsum, chalk, starch, or flour, white oxide of tin, zinc, sulphate of barytes or Chinese white, white oxide of lead. In combining, *e.g.*, magnesia with the glue, an addition of ten per cent. of glycerine gives elasticity and a horn-like clearness. To harden artificial ivory made with glue, the objects are dipped into strong solution of alum or tannin for about four minutes. The tannin is best made from gall-apples. Objects thus made have an antique ivory, yellowish hue. Red chrome alkali may be used in solution with water instead of tannin, but it gives a stronger yellow.

According to HYATT'S patent, artificial ivory is made by combining a syrup made of eight parts shellac and three parts of ammoniac with forty of the oxide of zinc. This is heated and subjected to pressure.

CELLULOID is the best material for making artificial ivory. It is made by the combination of cellulose or vegetable fibre in the form of cotton-wool treated with acid ; that is to say, gun-cotton and camphor. It is sold in thin leaves, &c., which can be softened at from 100° to 125° centigrade, so as to be moulded to any form. By infusion of colouring matter, such as oxide of zinc, cinnabar, &c., celluloid is made to resemble ivory, coral, or tortoise-shell. It has often been applied to making a perfect imitation of Florentine mosaic, and of course serves admirably to repair such work when broken.

A very strong cement for ivory, bone, or fine wood is made by boiling transparent gelatine in water to a

thick mass. Add to this gum-mastic dissolved in alcohol, this solution being one-fourth, and stir into it pure white oxide of zinc till it forms a fluid like honey. This is also of itself an artificial ivory, when prepared and dried in the mass. Another can be made by combining diamond cement (*vide* Glass) with powdered ivory and a little glycerine. Also with the same, or very strong white glue and powdered egg-shells, which latter should have been boiled. Also white of egg, gum-arabic, a very little strong vinegar, and levigated egg-shells.

Another recipe for such mending or making of ivory and similar substances is to take soft and very white paper in pulp, combined with cotton-wool, treated with very dilute acid or *strong* vinegar. To this add powdered egg-shells, made into paste with a little glycerine ; amalgamate this with the paper and cotton mixture as thoroughly as possible, and submit to strong pressure or rolling.

Cellulose in any form, whether made from cotton, linen, wood, or other vegetable fibrous substance, affords a basis which can be treated with dilute acid to produce a horny or parchment-like substance. A modification of this is seen in making celluloid with camphor. These modified forms of organic creation can be combined with other organic substances or minerals in great variety. Thus glycerine, and at times oil of different kinds, in such admixtures confers elasticity, or a diaphanous appearance ; ivory-dust has an affinity for oil and glue ; and these all combine with parchment, boiled ivory-dust, and fibrine or cellulose.

Certain marine plants, such as *kelp*, yield a fibrous

substance which has very peculiar qualities, and which admits of ingenious combination. Certain experiments and observations convince me that there is here a vast field, as yet unexplored, in which science will yet make discoveries and afford valuable contributions to technology.

The reader who is specially interested in this subject may consult to advantage *Die Verarbeitung des Hornes, Elfenbeines, Schildpatts und der Perlenmutter*, &c., von Louis Edgar Andés ; Vienna, A. Hartleben, price 3s.

REPAIRING AMBER

HOW TO PERFECTLY RE-JOIN BROKEN AMBER, AND TO IMITATE IT—HOW TO MELT AMBER IN FRAGMENTS TO A SINGLE BODY

Amber has been admired in all ages and everywhere from its exquisite colour and semi-transparency. Many superstitions were attached to it, and many still believe that to carry a bead made from it is good for the eyesight. It is principally found on the Prussian coast, off the German Ocean, but is also picked up in considerable quantities on the English shore. It is the gum or resin of a now extinct species of pine, which was probably much like that in New Zealand, which produces the gum *kauri*, which so much resembles amber.

Some amber is yellow and clear like lemon-candy. This is extensively imitated for cigar-holders and pipe-mouthpieces, beads, &c. Then there is the clouded, varying from white to straw-colour, and the beautiful golden-brown, which appears so rich in sunlight; also the dark-brown and black. These dark-brown ambers are generally seen in old ornaments, and are of a kind which is dug out of the earth. Light amber can be darkened to brown by an artificial process.

Gum *copal*, which comes from Africa, much resembles amber, but is less beautiful and more brittle. Gum *kauri*, from New Zealand, is very much like it. Both are used to imitate amber.

There are not many who know how to mend amber when broken. I am assured that the following is a trustworthy method :—Warm the pieces, dampen them with caustic potash (*ætz-kali*), and then press them together. When well done the joining will not be perceptible. It is said that by this process small pieces of amber, amber-dust, &c., can be made into blocks.

In imitating amber, the best pieces of copal are picked out, put into an air-tight vessel, and dissolved in petroleum, sulphuric ether, or benzole. After being dried in blocks this is submitted to a great pressure. As it dries the pressure is increased.

It occurred to me many years ago that the proper way to unite copal to a tough body like amber would be to use a tough or flexible varnish as a binding medium. I find by the work of Lehner on Imitations that he has verified this by experiment. What is also important is, that the process of hardening by pressure is by this means very much facilitated. I should judge, by all chemical laws, that a varnish infused with glycerine in combination with copal, kauri, or amber-dust would, even without pressure, form in time a substance quite as hard as amber, and much less brittle. It is to be desired that some technist would experiment on a variety of gums in this manner, and thus *fix* or render permanent their beauty. There is a wide field here to be worked. The subject of meerschaum and amber is fully treated in a work

entitled *Die Meerschaum- und Bernstein-Fabrikationen*, von G. M. Raufer ; Vienna, A. Hartleben, 2 marks.

I may add that carving amber is a very elegant art, yielding beautiful results. I have known a young lady, the late Miss Catherine L. Bayard, who excelled in it. It is effected chiefly with fine files and emery or glass paper, as, owing to its extremely brittle nature, there is much risk for any save experts to use cutting tools. Amber is a very expensive material, but objects made from it are of more than proportionate value. Those who would practise carving it should begin with pieces of copal. As I have already explained, small fragments and the dust of both amber and copal can be melted and combined with clear turpentine into large masses, which are even tougher than the native gums.

An inferior, but still very pretty, imitation of amber can be made by combining almost any gum properly clarified and coloured ; as, for instance, gum-arabic or dextrine with gelatine (best quality white) and glycerine. If thoroughly well combined and dried, this will wear as well as amber. Some of the gums of fruit-trees—*e.g.*, of the peach and cherry—are very beautifully coloured and clear, and seem to be admirably adapted to be hardened by the same process. They occur very frequently in old books of recipes as adhesives or cements. Perfectly clear glue or gelatine with glycerine and transparent dyes form an excellent imitation for beads.

INDIARUBBER AND GUTTA-PERCHA

MENDING INDIARUBBER SHOES AND MAKING GARMENTS WATERPROOF, WITH OTHER APPLICATIONS

Indiarubber or gutta-percha enters into so many familiar and useful objects that there are few people who would not like to know how to repair them when injured.

Like the brittle or non-elastic gums, caoutchouc (with which I include the nearly allied gutta-percha) is greatly modified by admixture with certain pulverised substances, which form with it a partly mechanical, partly chemical, combination. Those who would thoroughly study the subject in all its relations may consult *Kautschuk* (*Caoutchouc*) *und Guttapercha*, von Raimund Hoffer ; Wien, 1892, Hartleben.

Caoutchouc is partially soluble in carburetted sulphur, ether, pure petroleum, or benzole, but gutta-percha is perfectly so. In this state it may be applied as a varnish or coating for repairs, as it hardens by exposure to the air. When mixed with sulphur and exposed to a heat of 110° to 115° centigrade, gutta-percha becomes what is called "vulcanised," assum-

ing a very light grey colour, is more elastic, and retains this elasticity at a much lower grade than before. When the heat is raised to (maximum) 180° the mass becomes very hard, tough, and black, or like horn. The conditions of its toughness, elasticity, and hardness depend upon the amount of sulphur used ; as in other combinations, the harder the material becomes the less elastic it is—that is, the more brittle.

Ebonite is extremely hardened caoutchouc. It is first treated with chlorine, washed with sulphate of soda infused in water, and finally mixed with hardening substances and submitted to severe pressure.

As indiarubber or "gum" shoes are in general use, most people would consider them the proper objects to begin with. To do this, first make two separate preparations as follows :

I.

Caoutchouc	10
Chloroform	280

II.

Caoutchouc	10
Resin	4
Turpentine	2
Oil of turpentine	40

No. I. is simply kept for a time in a bottle or tightly closed jar by itself. No. II. is made by cutting the gum very fine, mixing it with the resin, then adding the turpentine, and finally dissolving the whole in the oil of turpentine. Then combine I. and II. To repair the shoe, take a linen patch, steep it in the mix-

ture, and place it over the rent. When this is dry apply one or more coats.

It may be observed that this preparation may be used not only for indiarubber shoes, but many other objects. Applied to the soles of leather boots, and then heated in, repeating the process a few times, they become perfectly waterproof. This is better when the shoemaker makes a coating of it between the two soles. I have tested this often. The inner sole may be made by simply dissolving the indiarubber in benzole or ether. A solution for ordinary repairing can be made by simply steeping the indiarubber in benzine.

Rents or holes in ordinary leather shoes or other objects can be very well repaired in this way. A piece of leather can in this case be substituted for the linen rag. Boots or shoes which will be very much exposed to wet should be warmed and then soaked or permeated with a solution of indiarubber. Preparations for the purpose can be bought of all dealers in gum and gutta-percha.

Cloth is generally waterproofed by steeping it in a slight solution of caoutchouc.

Another recipe (LEHNER) is as follows :—

Caoutchouc	150
Tallow	10
Slacked lime	10

This is used to cork or close bottles. To render it more resistant, substitute pipeclay for the lime. Or if in place of either we use red oxide of lead, it will form in time an extremely hard and perfectly waterproof cement of great value.

A STRONG INDIARUBBER CEMENT :—

Caoutchouc, about	90
Pulverised sulphur	10

Or from 6 to 12 of the latter.

This is specially commended as useful to close tins containing fruits, &c. It is simply vulcanised india-rubber.

MARINE GLUE is a very valuable and generally useful cement. It is so called because, being perfectly waterproof, it is used for many purposes in ships. It is applicable not only to repairing indiarubber or gutta-percha garments, but also to objects of metal, wood, glass, stone, paper, or cloth ; as, for instance, umbrellas, on which, when torn, a patch or strip of silk or muslin may be gummed, which will last as long as the rest. It is also good for waterproofing shoes. It is sold by dealers in ships' stores, chemists, and others. "It is a good thing to have in the country."

HARD MARINE GLUE :—

Caoutchouc	10
Rectified petroleum . . .	120
Asphalt	20

To prepare this, the caoutchouc should be hung in a linen bag in a cask with a very large bung, or in a large jar, so that the bag shall be only half immersed. This is kept in a warm place for from ten to fourteen days, till the solution is effected. Then the asphaltum may be melted in an iron kettle. Let the rubber solution slowly run into the kettle over a gentle heat, and stir in the one to the other till the mass is thoroughly preserved are put in the bag ; the edge is then turned

incorporated. When this is effected pour the mixture into moulds which have been oiled to prevent adhesion. The result is dark brown or black thin cakes, which are broken with difficulty. The excellence of this cement is somewhat counteracted by the difficulty or care which must be observed in using it. To do this, put the vessel in which it is to be melted in another or a *balneum mariæ*, as for glue, filled with boiling water. When fluid take the kettle from the fire and subject it directly to heat till it attains a temperature of 150° centigrade. When it is possible, heat the object to be glued to 100°. The thinner the coat and the hotter the surface the better will it adhere, unless the objects be such as hard boards. In all cases as strong a pressure as possible should be employed to bring the two parts together, which should be continued till the glue has dried. Boxes which are cemented together by means of marine glue and are also nailed are of extraordinary strength, and may be thus made air-tight and waterproof. Those who intend to send articles which can be affected by sea-air, such as silks and tea, which change their colour and quality even when packed in the tightest ordinary cases, should employ boxes well secured with good marine glue. It is also invaluable to secure clothing against moths, for if anything be very thoroughly dusted and there are no moths in it, none can get in if it be enclosed in a box rendered air-tight.

Apropos of which I would say that in America moths, which are far more of a pest than in Europe, are effectively excluded by means of bags of strong paper, well tarpaulined or tarred. The objects to be

over and warmed, so that it seals itself up. Strong paper bags are better than any trunks to exclude moths, but they must always be well gummed up. Tobacco is no protection at all against these insects. I have even had an old woollen Turkish tobacco-bag which had been in use ten years, and which was partly full of tobacco, almost devoured by moths, which must have eaten no small quantity of tobacco in so doing. Nor is camphor or any other scent half as effective as hermetic closing in some substance which insects will not eat.

Lehner gives a suggestion regarding the rendering walls air-tight which is of such remarkable practical utility that it ought to be enforced by health laws in every house. Whenever walls have any tendency to absorb dampness—and all have it in damp weather, especially in underground rooms—it is *far* more dangerous than is generally supposed to put paper on them. This is so much the case that where workmen, from carelessness, paste one coat of paper over another on a damp wall, the mass in time gives out a very poisonous exhalation, so that an instance is recorded in which several people died, one after the other, in consequence of sleeping in such a room. To prevent this take the following waterproof cement :—

Caoutchouc	10
Washed chalk	10
Oil of turpentine	20
Bisulphide of carbon	10
Resin (colophonium)	5
Asphalt	5

These are combined in a large flask, kept in a moderately warm place, and often shaken till well incorporated. The wall to be covered should be brushed and wiped, and in some cases heated, until extremely dry. Then, using the cement, apply the paper in the ordinary way. It will stick with great tenacity, this being a very tight and strong glue. All wall-paper whatever is more or less productive of malaria in damp weather, as is the smell of a *damp* library, or one where the scent of old paper is rankly and offensively perceptible. Therefore every precaution should be taken to render it innocuous.

Even if no paper be applied, this cement is very valuable when simply used to coat the interior or exterior of damp walls. It can, of course, be used to repair many articles of indiarubber, and to mend shoes, tan garments, &c. *Apropos* of which latter I may here remark that all persons who intend to rough it in the bush as colonists, or go into any region where mending or getting mended is difficult—as I myself have many a time experienced—would do well to carry a tight tin box of waterproof glue, with which torn shoes, and very often torn clothes, can be promptly repaired. In fact, with the aid of a little rough stitching, or even without it, garments of leather, muslin, and even of cloth can be made to hold together with certain cements, which will literally bind anything.

It is well worth while for those who propose to live in the wilderness, wherever it may be, to know how to prepare or make indiarubber garments. The recipe is very easily made :—

Gutta-percha	10
Benzine	100
Linseed-oil varnish	100

The gutta-percha is dissolved in the benzine ; the solution, when clear, is poured into a bottle already containing the varnish, and all is then thoroughly shaken. This mixture, when spread on woven fabrics of any kind, renders them completely waterproof. The garments can then be cut out and "sewed ;" that is, bound together with the same cement. According to LEHNER, this cement can be used for making the soles of shoes, and is marvellously elastic. All travellers, and assuredly all housekeepers, should have this cement among their possessions.

It may also happen to a traveller to find himself with an aching hollow tooth in a region where no dentist is accessible. Should he have with him some gutta-percha (bleached is best for this purpose) he may combine it with very finely pulverised glass. (To *levigate* or powder anything as fine as flour, it must be pounded in a mortar, or on metal or hard stone *under water*.) Then warm and thoroughly mix the gutta-percha and glass. Make it into little pencils, which, when they are to be used, must be dipped in hot water. This cement may be also used for a great variety of other purposes.

A very admirable cement, which should be found in every stable and known to every one who owns a horse, is made as follows :—

Hartshorn and resin ammoniacum (*Ammoniakharz*) . .	10
Purified gutta-percha . . .	20–25

Heat the gutta-percha to 90°–100° centigrade, and thoroughly incorporate it with the powdered resin. The chief use of this admirable composition is to fill up cracks or splits in horses' hoofs. It may also be used for plaster on occasion. To apply it to hoofs, warm it and spread it in with a warmed knife. It sets so hard that it will hold nails.

In mending or making, it may be observed that a very little indiarubber or gutta-percha may be combined with benzole or ether, or rectified petroleum in large amount, which soon becomes dense. Therefore, to produce a surface or a skin, we first spread a *thin* coat over the object or mould, and then apply another with a broad, soft brush or "dabber" with great care, so as to make it of uniform thickness. It is, therefore, best to have the preparation always rather thin, and use it at the right time, and not when it has become dense by long keeping. In the latter case add more of the solvent.

Glass bottles or vials containing liquids are often broken, even by the pressure of soft objects, such as clothing, when placed in trunks. It is therefore advisable to dip or coat them with this solution, which forms a bag which will contain the fluid ; that is, unless it be of a nature which will soften it. I have known a bottle of hair-oil to be packed in a valuable cashmere shawl, which was almost ruined by its breaking, and which could have easily been prevented by this easy precaution.

Any apothecary will make up these recipes.

A very curious and valuable imitation of indiarubber waterproof cloth is made as follows :—Caseine is macerated with water and with borax to a solution. The cloth is dipped in this, and when quite dry, again

dipped into a strong infusion of gall-apples. This is a kind of tanning.

For exhaustive information on the subject of india-rubber the technologist may consult *Kautschuk und Guttapercha*, by Raimund Hoffer, Leipzig, 1892, which is, I believe, the latest and best work on this important subject.

MENDING METAL-WORK OR REPAIRING BY MEANS OF IT

FIREPROOF CEMENTS, WITH IRON BINDERS

Metal-work, especially in iron, requires so much forging and so many appliances that it is to a certain extent beyond the ordinary mender, who must in most cases have resort to the smith or artificer. But there is still much within the capacity of the amateur to effect, and this I will describe.

One of the commonest requirements in repairing trunks and many other objects is to make a strap or strip of metal hold either to a surface or to itself. This is to be promptly effected by *riveting*. If the iron band on a trunk is broken, you cannot well nail it again into its place. A nail will not hold in the thin side, possibly of pasteboard. To learn how to repair in such a case, take a piece of common hoop iron, lay it on a block of wood or a board, and with a fine nail or brad-awl and hammer knock a hole in it. Then take a rivet or any flat-headed tack, put it through the hole, lay it with the head of the tack down on iron or stone if possible, and then give the point a blow, a little sideways. The result is that the point will be flattened and the tack firmly held. The

result will be the same if the rivet passes through two thick pieces of metal. In this manner the two ends of an iron hoop for a box are fastened. Therefore, if we take a piece of tin or sheet-iron, put it in the trunk against the side, and bring down the broken strip on the outside, we can, with a little care, rivet it. It is advisable, when this is done, to paste a strong piece of muslin or leather over the tin to prevent it from cutting anything in the trunk. These riveted strips are *far* better for surrounding and holding many bundles than cords. They are better for books, because they do not leave marks on the edges, neither do they untie nor are they hard to fasten, requiring no knotting.

Riveted bands, corners, or bent pieces of sheet-metal are more generally applicable to broken furniture than is generally supposed. The plate thus applied can generally be concealed either by chiselling a place for it or by hammering it into the wood, and then cementing and painting it over.

Wire is also very useful for mending of many kinds, either in metal or wood. To manage it we need a pair of cutting pliers or pincers, as well as the long-nosed and flat pliers. Thus, to attach two bodies—for instance, the two parts of a broken gun-stock—begin by fastening one end of the wire in one piece, and wind it round both, drawing it as tightly as possible with the flat pliers. When united, fasten the other end by driving it under the *twist* or into the wood. This also can be so adroitly treated that the wire, flattened with a file and hammered down, can be concealed under paint and varnish. By means of wire passed through holes made with long brad-awls

or fine gimlets, picture-frames can be firmly repaired. In many cases the wire should be brought round and the ends fastened or wound together ; in others, make a double ring in one end of the wire and nail it down, then pass the wire through the hole and fasten the other end in the same way. Many kinds of broken implements may be thus mended. Endeavour to get strong, *flexible* wire for such purposes.

Boxes containing goods will be doubly strong when protected by strips of iron nailed round them. Hoop-iron is generally used for this purpose.

Soldering is, however, the best and most usual means of repairing all kinds of metal-work, and this is very far from being so difficult as is generally supposed ; indeed, a lady-writer on metal-work goes so far as to declare that it is fascinating. As every tinker and tinman knows how to "sodder," and will willingly give instruction for a trifle (children, indeed, often behold the whole process admiringly for nothing), and, finally, as it is most unlikely that any reader of this work should be in a place where neither tinkers nor tinmen are to be found—for I have read that a gipsy tinker was once discovered mending a kettle seated in the shadow of the Great Wall of China—it is hardly necessary to describe in detail processes which any one can take in at a glance. The principle is this :—As in cementing glass, the glue which binds requires powdered glass to be mixed in it, so that it may establish a quicker and closer affinity with the glass ; so to unite two metallic surfaces we must have a flux or some fusible substance as an intermediary. For this purpose various substances, such as resin and borax, are employed with

the solder, which is a compound of metals, which melts very easily, takes a firm hold of other metals, and sets hard at once. There are many varieties of it, adapted to different metals. It is generally sold in small sticks for use.

I lay some stress on the fact that there should be some one in every family knowing how to repair, especially in metal, because there is no household in which there is not damage of tin and iron ware, trunks, kitchen utensils, and often even of jewellery, which a clever youth or young lady could easily restore. A pin is detached from a brooch. You could repair it yourself in five minutes, at a halfpenny's expense ; but no, it must be sent to a jeweller's to be mended for a shilling. It is the same with earrings and chains and bracelets and clasps and securing-rings. When they become shaky you fasten them with thread. It will hold for the present, of course ; and then comes an advertisement in the *Times:* "Lost—Twenty-five Pounds Reward !" All because you never learned how to repair or solder.

But, as 'tis never too late to mend, and no one should be a mend I-can't, or go begging to others to do for him what he can do for himself, I trust that reflection on this subject will induce many to become practical repairers. If you have a valuable coin, do not take half the value out of it, as most people do, by boring a hole through it. Make a simple twist and eyelet of a bit of silver wire and solder it on the

edge. Do not tie a gold chain with twine ; mend it properly. Rivet your broken scissors, and when hinges come out screw them on again. If there were really anything *difficult* in all this I would honestly say so, but there is not, and people who have received some education learn how to do it all with ease in a short time.

A recipe for a cement to attach metal to any other substance is made as follows :—

Purified flint-sand (or glass-powder).	10
Caseine or curd	8
Slacked lime	10

Mix thoroughly, and add water to a creamy consistency.

The following for metals is also very strong :—

Sturgeon's bladder solution . .	100
Nitric acid	1

The acid is stirred in at the same time with the cement, which should be as dense as possible, and with this mixture the surfaces of the metal are covered. " The nitric acid is intended to make the surfaces of the metal rough, but it has the drawback that it hinders the drying of the glue" (Lehner). This slowly drying is, however, a great advantage. The same is found when it is mixed with common glue, which generally dries too rapidly. Cements which dry rather slowly take hold the most firmly and permanently. The acid hardens the mass by contracting the cellular tissue. To hasten the drying, the metallic parts, which should be very strongly compressed together, must be exposed to heat.

A simpler method for light articles of metal is to wet the surfaces with nitric acid for a few minutes till they are roughened, then wash away the acid in water, and cement the metal with sturgeon's bladder cement.

A special cement for zinc is made by thickening very strong dense glue with powdered slacked lime, into which is kneaded one-tenth part of flowers of sulphur.

A so-called Jeweller's Cement, which holds firmly, is the so-called Diamond, elsewhere given ; also the following :—

Sturgeon's bladder	100
Gum mastic varnish	50

The sturgeon's bladder is dissolved in as little water as possible with strong spirits of wine (equivalent to ordinary spirits). To prepare the mastic varnish, mix finely powdered mastic with the most highly rectified spirits of wine and benzine, and use as little liquid as possible. The two mixtures must be then rubbed as intimately as possible together. When carefully made this cement will serve for anything—glass or china, &c.

A CEMENT FOR ZINC, especially for ornaments and small work :—In ten parts by weight of silicate of soda (solution) stir two parts of cleansed chalk and three of zinc in powder. This is kneaded for some time into a putty, with which defects, roughnesses, &c., can be remedied. After twenty-four hours, when polished with agate, this cement has all the appearance of zinc.

It may be observed that other metals in fine powder

may be substituted for the zinc, and that with bronze powders, oxides of metals, and indeed with all the range of painters' colours, combinations may be formed of infinite application in the arts. According to LEHNER the silicate of soda should be of 33°.

A specially strong and valuable cement, capable of many uses in metal, wood, glass, or china, or to fasten glass to metal, is made as follows :—Take best purified litharge, stir it with glycerine until it becomes a thin homogeneous mass, which in less than an hour will become a very hard mass, which is of almost universal application. It is not affected by water, and resists the action (according to LEHNER) of almost all acids, the strongest alkalies, as well as etherised oils and the fumes of chlorine and alcohol. The surfaces which are to be united with it must first be covered with pure, thick glycerine.

It will readily occur to the reader that in or to this, as in every recipe given in this book, modifications, alterations, and additions can be made, of very great value, adaptable to a great variety of substances. It is to be observed that in such cases as this, where one cannot be sure of the exact result, it is best, *e.g.*, to first experiment with a very little finest pulverised oxide of lead with the glycerine.

Another form of this powerful metallic cement is given as follows :—

Concentrated glycerine . .	½ litre
Litharge	5 kilogs.

To make a cement to fill or close joints in zinc-work :—Soak three parts by weight of glue in water, pour off the superfluous water, dissolve the glue in

warm water, stir into it six parts of slacked lime and one of flowers of sulphur.

When ironwork, as, for instance, window-bars, is to be set in stone, the following is commended as taking a firm hold :—

Calcined gypsum	30
Finely powdered iron . . .	10
Vinegar	20

The following recipes, though I have found many of them in other works, are here taken, with acknowledgment, from LEHNER, as his proportions are invariably accurate, or confirmed by experiment.

AN IRON CEMENT which resists heat and moisture :—

Clay	10
Iron filings	5
Vinegar	2
Water	3

A VERY STRONG WATERPROOF CEMENT FOR IRON :—

Iron filings	100
Sal-ammoniac	2
Water	10

This in a few days will begin to turn into a hard rust.

Another OXIDISED CEMENT, which holds like iron, is made as follows :—

Iron filings	65
Sal-ammoniac	2.5
Flowers of sulphur	1.5
Sulphuric acid	1

The sulphuric acid is diluted with water and added to the mixed powders.

A RUST OR OXIDE CEMENT, resisting fire :—

Common iron filings	45
Clay	20
Finest porcelain clay	15
Salt in water	8

Fine clay may be used in lack of the finest porcelain clay.

AN IRON CEMENT to resist heat :—

Iron filings	20
Clay in powder	45
Borax	5
Salt	5
Peroxide of manganese	10

The borax and salt are melted in water and then quickly mixed with the remaining ingredients, which are in a combined powder. At a white-heat this becomes a glassy substance, which seals hermetically.

IRON CEMENT to resist intense heat :—

Peroxide of manganese	52
White oxide of zinc	25
Borax	5

This is applied with silicate of soda. It must dry gradually.

IRON CEMENT to resist heat :—

Iron filings	100
Clay	50
Salt	10
Flint-sand	20

FIREPROOF CEMENT :—

Iron filings	140
Hydraulic cement	20
Flint-sand	25
Sal-ammoniac	3

This powder is made into a paste with vinegar. It must dry for a long time before being submitted to heat.

Another cement of the same kind is as follows :—

Iron filings	180
Clay	45
Salt	8

This is also made up with vinegar, and must be dried for a long time.

TO SET IRON IN STONE :—

Iron filings, fine	10
Calcined gypsum	30
Sal-ammoniac	0.5

Also combined with vinegar.

When there are defects in iron castings, they may be filled up with the following cement :—

Clean iron filings	100
Flowers of sulphur	0.5
Sal-ammoniac	0.8

To be mixed with water to a paste. It does not fuse nor act as a paste until exposed to great heat. Before applying it wash the edges to be united with liquid ammonia. Brimstone or sulphur melts iron very promptly when the latter is red-hot, and applied to it, the iron will drop like melted sealing-wax.

A CEMENT FOR IRON STOVES is made as follows :—

Iron filings	100
Chalk-marl	40
Flint-sand	50
Vinegar	20

This is made into a paste, which can be rendered porous by mixing with it bristles, chopped straw, sawdust, or chaff. When the latter is converted to coal by heat, the cement is, of course, full of cavities. In like manner, clay for water-coolers is made light and spongy by mixing it with salt. The salt gradually melts in the damp clay, forming a porous substance.

When iron doors are to be hermetically sealed at very high temperatures the following may be used :—

Finest iron filings	100
Sal-ammoniac	1
Limestone	10
Silicate of soda	10

When the iron plates about a fireplace give way the following may be used :—

Iron filings	20
Iron dross or refuse	12
Calcined gypsum	30
Common salt	10

This mixture may be combined with either blood or silicate of soda, preferably the latter, as the former has a disagreeable smell.

Iron filings mixed with vinegar are allowed to stand till of a brown colour, and then driven with plugs and hammer into cavities, where they form a rust cement.

For cracks in iron pots, &c.:—

Iron filings	10
Clay	60

This is mixed with linseed-oil to a paste. It requires several weeks to harden, but forms a hard cement.

A black cement for ironware:—

Iron filings	10
Sand	12
Ivory black	10
Slacked lime	12
Lime water	5

Schwartz's iron cement for holes in pots, &c.:—

I.

Finely powdered glue	4–5
Finest iron dust	2
Peroxide of manganese	1
Common salt	½
Borax	½

To be powdered extremely fine or levigated and made with water to a paste. Resists fire and hot water.

II.

Pulverised peroxide of manganese	1
White oxide of zinc	1

To be finely pulverised and combined with silicate of soda.

An important part of all metal-mending is soldering. This is based on the principle that certain

metallic compounds which fuse at a very low heat can, however, be so brought into union with others which have an affinity for them as by melting to unite the harder objects. Thus bismuth, which will melt in hot water, has an affinity for lead, which combines easily with tin and brass, &c.; as, in like manner, borax and resin with iron.

NEWTON'S SOLDER (LEHNER) :—

Bismuth	8
Tin	3
Lead	5

This melts at 94.5° Celsius.

ROSE'S SOLDERS :—

I.

Bismuth	2
Lead	1
Tin	1

II.

Bismuth	5
Lead	3
Tin	2

A METALLIC-GLASS SOLDER :—

Lead	30
Tin	20
Bismuth	25

The lead is first carefully melted, then the tin added, and the melted mixture carefully stirred ; the bismuth is put in last of all.

CEMENT FOR IRON STOVES :—

Wood-ashes	10
Clay	10
Calcined lime	4

To be mixed with water to form a firm paste. Also applicable to holes in trees. Clay mixed with waste-paper is also applicable for the latter purpose (LEHNER). (Glue may be added to it.) This mixture of clay and paper should be well mixed with sour milk.

CLAUS'S CEMENT FOR METAL AND GLASS :—40 grammes of starch and 320 grammes purified chalk are dissolved in 2 quarts water, into which is stirred ½ pint solution of caustic soda.

The most important part of mending broken metal-work is *soldering*, and this is so difficult to practically teach by mere *writing*, while it can be so easily learned from any tinsmith, or even tinker, that I deem it common-sensibly best to acquire it from the latter. Those who would study it in all its details, scientific or technological, may do so in *Das Löthen und die Bearbeitung der Metalle*, by Edmund Schlosser ; Vienna, A. Hartleben, price 3s.

REPAIRING LEATHER-WORK

TRUNKS, SHOES, OR IN ANY OTHER FORMS—JOINING STRAPS—MAKING CHEAP SHOES

Leather-work when much worn is seldom restored, and, except by a few experts, it is generally regarded as incurable. That is to say, that leather-work is only repaired by the same method in which it is made —that is, by sewing—when in fact a great deal is lost which might be saved, and much imperfectly repaired which might seem like new by resorting to a more scientific process. And therefore, having devoted much attention to it, I am persuaded that the worst cases may be mended. Within a week I purchased two small folio volumes which had been beautifully bound in black leather, embossed in deep relief, about 1520, in a style which was then becoming antiquated. The pattern had been cut in a wooden mould, stamped on the wet leather, and then completely worked over by hand with tracers and matted or stamped in the ground. But the black colour had been worn away from the relief and turned brown, and it was otherwise dilapidated at the edges.

I took a volume and where the surface was ragged moistened it, applied gum-arabic in solution, and

smoothed it down with an agate burnisher. Leather treated in this way soon becomes like a paste. When it was all even I painted it over with strong liquid Indian ink. Common ink would have done as well. Then I varnished it over lightly with the admirable *vernis à retoucher*, No. 3, of SOEHNÉE, which is flexible, preservative, and does not crack. I may add for ladies that it smells like *eau de cologne*. This dries almost immediately. It may be had at all artists' material shops. Finally, I rubbed it for some time by hand. Then the binding was as good as new, yet not too new. It was simply perfectly restored.

I have in the introduction mentioned another work which I also restored. This was a Madonna in high relief, very much dilapidated ; that is to say, it was of thin leather, which had been originally made in a mould, and was accordingly puffed out, so to speak, like a pie-crust. On the mould there had been laid a coat of muslin or cotton fabric ; this, when dry, had been very thinly covered with *gesso* or plaster of Paris, and on this, when dry, a thin wet leather had been pressed. I may here note that very often the *gesso* was then blackened without any leather being applied, and that when thus blackened, covered, and varnished it looked exactly like leather—an easy art, which may be practised to profit by any one who can carve or buy moulds.

On examining this, I found that it would be very difficult to repair it with good leather. I found in a shop some thin black sham-leather, such as the Japanese apparently manufacture from leather dust, made by grinding up all kinds of leather waste to a powder. It was wretched, rotten stuff as leather, but all

the better suited to my purpose. Some of this I cut into small bits, and with a knife soon mashed it, mixed with gum-arabic and water, into a very smooth paste. With such a paste one can repair any tear, roughening, or imperfection, care being taken that the paste and leather be alike in colour. With this I filled the hollows at the back, making the work solid ; and having wetted all the ragged edges and fractured or torn places, smoothed them down with gum and a pen or paper knife, supplying deficiencies with the black paste. When all was smooth and dry I applied a coat of SOEHNÉE's varnish, and then rubbed it well down by hand. It was quite restored.

As this varnishing leather may sound like a heresy to artistic leather-workers, I would ask them if they would consider an application of tannin in solution—which is the preservative principle of leather itself—as "inartistic." Certainly it is not, nor is the application of SOEHNÉE (which is more of a simple preservative than a glaze) a mere finish for show.

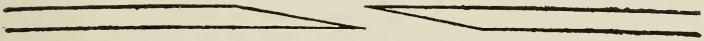
The leather-paste of which I speak has certain qualities of its own which make it quite different from any other substance. We may include in leather "paste" not only the mere dust made from the dried substance, but all scraps, and also any thin leather, thoroughly softened or macerated. Even in the latter form it is, combined with a binder, really a plastic substance, since it can be worked into any form with ease. Mixed with caoutchouc or indiarubber in solution, and then dried, it is invaluable for mending boots and making waterproof soles. As I have indicated, it is excellent for mending old books. And

here I may mention that if you have, let us say, one cover of a book in high relief, and the other, it may be, lost or worn plain, you can supply or make the duplicate very easily, very cheaply, and in a short time as follows :—Take a sheet of soft, white newspaper, dampen it, and press it on the relief. As soon as possible, taking care not to wet the book, fill in the back of the *squeeze* either with other coats of wet paper, melted wax, or liquid plaster of Paris. When this is dry, wax or oil carefully the face of the squeeze, wipe it dry, and make a cast from it in *leather-paste*. Thus you will have a facsimile of the relief. From a solid plaster mould, well oiled or boiled in wax, a cast may be taken in softened or wet leather, which is even better ; it sets hard and tough.

I may here mention that it is very unusual to see books bound in deep relief with *hand-worked*, black, or black and gold, antique patterns, and that such a cover, say of eight by ten inches, would probably cost at least a pound, and be cheap at that. And yet any girl of ordinary capacity with, let us say, fifty shillings' worth of moulds, and two weeks' practice in tracing and stamping grounds, could produce from two to four such book-covers as those before me in a day.

There is now generally sold in furnishing or chemists' shops a good waterproof glue. Leather softened and then well incorporated with this is also waterproof, and may be used to mend trunks. I have known a torn boot to be mended in this manner, and that so well that it lasted for a long time. Even a leather strap which is subjected to great tugging may

be restored, if cut or broken in two, by shaving the edges obliquely, so as to sharpen them.



Then apply glue with acid, and before it is quite dry apply pressure, though not so great as to squeeze the glue out. Shaving across the edges, judicious pressing together, and final smoothing are of the greatest importance in all leather patching and piecing, because it depends on these to make the juncture imperceptible. Very few persons—even shoemakers—are at all aware of the degree of perfection to which mending rents in foot-covering can be carried by the use of waterproof glue, such as is sold by many chemists. I have worn such a patch for months, and it was hardly perceptible. But, like every art, it requires some practice to apply such patches properly, and I cannot promise to any lady that she can perfectly and neatly patch a boot by simply daubing on a piece of leather at a first trial.

It may be noted that in such strap-joining as that which I have described, the repair will be greatly strengthened by pasting very thin bits of leather, or even of muslin, over the edges and pressing them in. It is true that this cover will soon wear away, but meanwhile the mended leather is all the while growing stronger and uniting more perfectly. Even paper, glued and pressed on, materially aids to make the exposed joint unite.

And here I may say that many a lady and youth would do well to take a few practical lessons from

any shoemaker in the noble art of cobbling ; that is to say, of heeling, soleing, and patching, all of which are as easy to learn as steps in dancing, and are even more interesting or amusing when once mastered. It is, moreover, an art which will be of use through life. Those who can do this will probably, if ambitious by nature, progress to making slippers, it may be shoes ; and he who can do this may be assured that he never need quite starve to death while human beings go shod. It is not so difficult as many think, for I have known shoemakers of very ordinary minds, and I also once knew a mechanical artist who learned to make a fine pair of shoes in a few weeks. In fact, there is a living in a great many things for those who have once learned to use their fingers.

Few people are aware of the extraordinary durability of leather-work of certain kinds. There are in the British Museum Roman sandals, probably made of raw hide, but cut into pretty form, which were found in the Thames, and which look as new as if recently made. I have seen within a day as I write a gracefully formed pitcher of the early fifteenth century of very solid black leather, like the old black-jacks once common in England, which has probably passed through centuries of use, and is as perfect as ever. Wood splits, earthenware breaks, and metal rusts, but raw hide, or *cuir bouilli*, as set forth in the old song of the "Leather Bottél," seems to endure every trial. As the man commemorated in "Æsop's Fables" declared, "After all, there is nothing like leather." The reader who may be especially interested in this easiest of all the minor arts may consult on this subject my *Manual of Leather-Work* (5s.) ;

Whittaker & Co., 2 White Hart Street, Paternoster Square, London, E.C.

Strips of raw hide are without equal for repairing broken vehicles, wheels, saddles, and similar articles, because they shrink while drying, drawing everything tight, and set so hard when once dry that what is mended is often stronger than before. I have elsewhere mentioned that the strongest trunks in the world are made in America from it, as they had need to be, since there is no country in the world where the "baggage-smasher," figurative or literal, is so much to be feared.

The reader who has occasion to repair anything in leather should study the chapter of this book which treats of indiarubber and gutta-percha, the subjects being in many respects the same.

A strong cement for leather is made by combining gutta-percha and *Schwefelkohlenstoff*, or bisulphide of carbon, with petroleum to a syrupy consistency. A very good cement specially adapted to joining leather straps is as follows :—

Asphalt	12
Resin	10
Gutta-percha	40
Bisulphide of carbon	150
Petroleum	60

The materials, excepting the *Schwefelkohlenstoff*, are put together in a bottle which stands in hot water for several hours ; when the mass has grown thick with the petroleum add the rest, and let the whole stand for several days, shaking it very often. If the pieces of leather to be united are first heated and then

pressed very tightly together, the adhesion will be increased. This cement is as well adapted for glass, crockery, horn, ivory, wood, or metal as for leather. It is admirable for mending trunks, whether made of leather, wood, or pasteboard.

When a trunk is made of any of these, and a hole is broken through the side or top, take a newspaper and coat it with this cement, applying another, till there are a dozen or more thicknesses. If, as it gradually dries, this be pressed and hardened with a roller, or even a round ruler, it will be much improved. Glue this into or upon the fracture. In most cases with care it can be made as strong as ever. Where a rib is broken it should be promptly replaced. (*Vide* Metal-Work.) All trunks should be covered with waterproof glue or varnish, as it effectually protects them from exposure to the rain. This is very rarely done, however, the result being an immense amount of loss to all travellers. In any town where there is a chemist's shop, and where a bit of india-rubber is to be had, even at the stationer's, a waterproof cement can be at once manufactured. The easiest of these to prepare is the following :—

Gutta-percha	100
Pine resin	200

The resin is first melted in a pan, the gutta-percha, in very small bits, being gradually stirred in till all is amalgamated. When used it must be warmed again. This cement can be used for as many different articles as the preceding.

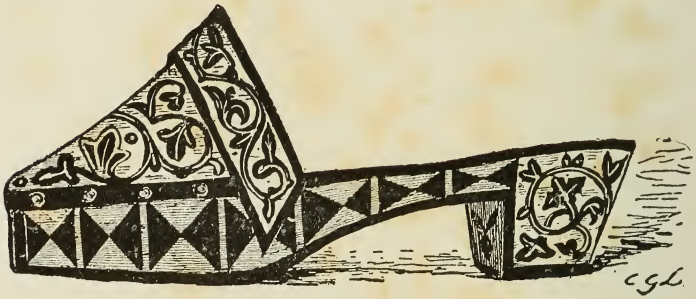
It may here be noted that vast quantities of waste leather from shoemakers and bookbinders, which sell

for a mere trifle, can be utilised to make admirable waterproof carpets and wall-covers. The leather is first soaked till soft, then smoothed out and mixed with waterproof cement, and rolled into one flat piece. This makes a very cheap sub-carpet for winter—better than oil-cloth, being softer. For walls it can be pressed in moulds, gilded, or painted. If varnished there is no unpleasant smell from it. The harder it is compressed or rolled the more will all smell disappear. Even with rolling by hand with a bread-roller almost all substances—for instance, paper, cloth-rags, sawdust, leather, clay, wool, cotton-wool, when combined with any fit adhesive or cement—can be made very hard or tough ; and it is remarkable, considering the cheapness of the materials, how little this principle is as yet applied.

It may be remarked that there are many people who do not know what to do when the sole of a boot splits off or wears away and there is no shoemaker at hand. If the heel is lost and no leather can be had, a very good substitute can be cut from wood and cemented on. A few tacks will make it last as long almost as leather. If a piece of sole leather can be got, even from another old shoe, one or two layers can be cemented on to make a sole. A short screw or nail through three-quarters of the heel greatly aids in making the layers adhere. This may also be done with a vice.

In the town of Bagni di Lucca, where I now am, a pair of leather shoes with wooden soles, such as are commonly worn by women and children, cost only fivepence. They are, of course, rough, but still far better than none. The sole is rudely and very easily

cut, with a high heel, from white pine or larch wood. The upper is a single piece of leather, which only covers the front half of the foot. It is moistened and bent into shape, and then tacked or glued on. Many people simply buy the soles, then the leather, and



Italian (Lucchese) Peasant Shoe, costing from 5d. to 8d. per pair, undecorated.

make the shoes for themselves, in which case the expense does not amount to more than twopence. In Florence there is often added to this the back, or heel-piece, which costs twopence more, and makes an almost perfect shoe. This art would be worth knowing in a wild country.

Lehner (*vide* Indiarubber and Gutta-percha) specially commends for mending soles the composition of—Gutta-percha, 10 ; benzine, 100 ; linseed-oil varnish, 100. It is extremely elastic and tough, and therefore suitable to soles. Mixed with black dye, or made with japan, it forms patent leather or polished leather. It should for this purpose be applied with a broad brush in *thin* successive coats, and well dried before applying a new one. This is far supe-

rior to ordinary blacking ; it is more easily applied, and does not injure the leather so much, because the latter is often made with vitriol, which, while it promptly gives a shine, eats away the fibre. Boots and shoes will, in fact, wear much longer with this coating than without it.

This is even more applicable to a great deal of harness, saddle, and bridle mending, and restoring sheet leather in every form ; as, for instance, waggon curtains, when worn and dry. First soften the leather, then restore its quality, if required, with tannin or indiarubber in solution. If very dry and exhausted, it may first be treated with neat's-foot oil for several days. Then sew it up, if a seam, or mend by applying leather and the cement. If all persons who own much harness would carefully study this subject, they would be astonished to find what economy could be effected by judicious mending.

It may happen that the reader may have occasion to wish to renew black, glazed leather-work, or to make a brilliant black pattern on a brown ground in stamped leather. I have often executed it with success. In such a case it suffices to simply blacken the leather with ink or dye, and then coat it with any flexible varnish ; that is, one into which glycerine or gutta-percha has been infused. Any one who can draw can in this manner execute very beautiful work for covering walls, panels, chests, or doors. Or flexible black varnish can be directly applied.

Leibner gives a recipe for attaching leather to metal, which may also be applied to any other substance :—Cover the leather with a thin and very hot coating of glue, press it on the metal, and then wet

the other side with a strong solution of gall-apples or tannin (*Lohe*, extract of oak-bark) till it is thoroughly penetrated. The tannin combines with the glue, and attaches the leather with extreme tenacity to the metal, &c. It is advisable to roughen the metallic surface to facilitate adhesion.

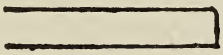
By combining glue (and many other adhesives) directly with the tannin or gall-nut astringent we obtain *a waterproof cement* of great strength, which is very useful for shoes. It is, in fact, not at all a difficult matter, where other appliances are wanting, to make from leather, without sewing, a soled shoe when tannin and glue are obtainable. The same can be done with canvas.

During the great wars in America thousands of soldiers often went barefoot in winter-time, with abundance of horses or cattle killed all round them, because they did not know that a strong moccasin can be made by cutting out a piece of raw hide, piercing holes in it, and drawing it up like a bag round the ankles, as is so commonly done here in the mountain districts in Italy. I once astonished a soldier in the war by suggesting this, and he declared he must try it. It is remarkable how rarely man in an uneducated state ever *invents* anything, be it a myth, a tale, or a practical invention.

If the upper leather of a slipper or shoe be cut out, it can, if wet, be easily made to assume the form of a foot by drying it on a last, or even on another shoe. Let the seam of the back jut or flap over the edge, and allow full selvage for the rest to turn under the sole. The latter may be of sole leather. If there is none, glue two or three pieces of the leather together with

the tannin cement, and roll them over strongly. Then glue the back and the under-lap with great care. With a little practice a fairly good shoe can be thus made. Canvas can be used in the same way. To dwellers in the wilderness this may be valuable information. But very pretty ornamental slippers can be made by young ladies out of scraps of gaily coloured leather. They can buy a pair of soles, and get the leather at a leather-dealer's. This is all simply substituting glueing for sewing, and strong tannin-glue holds *quite* as strongly as a great deal of the sewing of cheap, machine-made shoes. It would, indeed, not be a very difficult or expensive thing to shoe or clothe all mankind comfortably, were it not for the fashions followed by the wealthy.

These very cheap shoes, made with either wooden or leather soles, and that so easily that a child can learn to manufacture them in an hour, can be easily ornamented so as to be really attractive. Take the leather, moisten it with a sponge, and then with a tracer, which is like the end of a screw-driver—*i.e.*—



draw a pattern in the damp, soft leather. When it dries the pattern will remain. Then with a point or stamp, dot or roughen the ground. Finally, when dry, paint the pattern black, and then varnish it. Anybody with the least knowledge of drawing can make and sell such ornamented shoes for a good profit, as they are as yet hardly known to anybody.

Other colours may be substituted for black, or gilding applied.

I have in another place shown (*vide* Papier-Mâché) how good artificial leather can be made by combining paper—best in pulp—with indiarubber and benzole fluid solution. Also how soles can be made by steeping pasteboard in the same, and how these, which are very easily and cheaply made, can be glued on to the leather so as to protect the latter from wearing out, for ever, if renewed. A bottle of this cement, combined with Diamond or Turkish Cement, will in like manner repair boots when the sole begins to split or part ; and if applied when it begins to gape, it will be closed for a long time. This is such a practical, cheap, and easy method of making boots and shoes last, that my wonder is that every man who goes shod, and especially every traveller, has not a bottle of it by him. Observe that the two edges should be well pinched or screwed together (a sixpenny vice will answer for this), and the leather first heated, though all this is not a *sine quâ non*, but only an improvement.

Leather thus attached by a very strong cement is quite as durable and much pleasanter to wear than "copper toes" or iron heels, which assimilate their wearers to horses. And it takes no longer to make and attach a heel or a sole in this manner than to black a pair of boots, as I have myself verified within a few hours.

Where seams *rip out*, the best repairing is by sewing as shoemakers do, which is not hard to learn, and I advise all young people to learn it. But where sewing cannot be resorted to, the cement, well applied

and compressed till dry, will hold almost any break for a long time.

I urge ladies of all classes and conditions to carefully consider this chapter. They are more accustomed to repairing than men, and will take to it more intelligently. As their *chaussures* are made of thinner leather than ours, they need repair oftener, but are, on the other hand, so much the easier to repair. Every mother of a family will at least profit by studying this book.

Shoemakers' paste, much used for shoes, belongs properly to leather-work. It is made by boiling crushed barley to a thick mess, the water being kept extremely hot. It is then set aside till fermentation begins, which announces itself by an extremely offensive smell. Thence it passes to a stage in which it is a brownish syrupy mass, possessing great power as an adhesive. It is now taken from the fire and a little carbolic acid added to arrest fermentation. This can be used by itself for an adhesive ; it also combines well with *indifferent* substances, such as powdered lime, or chalk, white zinc, ochre, clay, or umber. It may be as well used for binding books.

I have already given a very good recipe for reuniting broken leather straps. I here add another from LEHNER. It is very good, but hardly worth the very considerable extra trouble and expense as compared to the former :—

Gilders' glue	250
Sturgeon's bladder	60
Gum-arabic	60

Reduce to bits and boil in water to a solution, to which add :—

Venice turpentine	5
Oil of turpentine	6
Spirits of wine	10

The strap-ends, or pieces of leather, having been thoroughly cleaned, are now covered with the adhesive and pressed together between hot plates, where the work must remain till cold.

A very good artificial leather, perfectly waterproof, may be made by covering a strip of strong paper, or, better still, one of glazed muslin, with the gutta-percha cement. Add to this fresh layers of cement and paper, till the requisite thickness is obtained. This is useful for mending soles. Where the gutta-percha or indiarubber cement is not to be had, substitute copal varnish and glycerine, or thick turpentine varnish and a little glycerine.

TO MEND HATS, BLANKETS, AND SIMILAR FABRICS BY FELTING

Wool, as is well known, if put into a pair of shoes, will pack or settle into a solid felt sole if the shoes are worn. This felt is like cloth. The same can be done by rolling it like dough on a board with a roller. Lay the cloth or hat to be mended so that the felt to be made can be worked into it. Then take fine wool and clean and roll it thoroughly, working it into the edges. It may happen many a time to a man without a needle to succeed in mending garments in this manner.

Waterproof glue or adhesive, such as is fully described in the chapter on Indiarubber, may be added to facilitate the adhesion of the felt to the cloth or felt ground. There is a peculiar art or knack of working moistened felt into the edges of cloth, and of ironing or pressing them down so as not to show, which can, however, be soon acquired. In this way cloth may be glued upon cloth with very good effect. The extraordinary tenacity and fineness of the adhesives now made, be it specially observed, renders mending of this kind (which was impossible a generation ago) now perfectly possible. I advise those who doubt this to get a piece of cloth and experi-

ment for themselves. The patch may not be invisible, but it will look better than if botched with a needle. Felt, however, can easily be repaired to perfection.

Large pieces of stuff can be made by rolling slightly gummed wool, which fact many men do not know, even when living in the wilderness, where wool or hair may be abundant. Nothing is so common as to see shepherds in utter raggedness where the very shreds of wool left by their sheep on the thorns would clothe them, with a little industry. The quality, durability, and fineness of felt depend on the quality of the wool, and the care and skill of the operator. Many of the cheap cloths known as shoddy are really felts.

Felt is easily formed, because under certain conditions it seems to have a strange tendency to form itself. The reader knows that a string in the pocket, subjected to our every movement, will inevitably tangle and knot itself up in the most mysterious manner; and so the fibres of wool, if rubbed together, twine and bind themselves into most intimate union. I earnestly advise all who expect to live where sheep are plenty, and tailors or seamstresses few and far between, to experiment in felt-making, and, if possible, learn from a hatmaker how it is done. There was at one time in New York a factory where strong, serviceable suits of felt cloth were made, and these, consisting of coat, waistcoat, and trousers, were sold at retail for five dollars, or one pound—I myself having seen them.

When a piece of cloth is thus adjusted or applied to fill a hole or mend a rent, the edges may be either

simply gummed and adjusted, or they may be treated with a mixture of felt or cloth-dust and gum. In this case, before the adhesive is *quite* hard, yet after it has ceased to be soft, lay over the patch a piece of cloth of exactly the same kind, and press it with a warm flat-iron. (*Vide* Invisible Mending of Garments, Laces, or Embroideries.)

In most cases a torn woollen garment may be very well restored by carefully sewing a piece into the hole, or by uniting the edges with long stitches. Then make a paste of felt or dust, or short, fine threads of the same cloth, with indiarubber cement, and work it over the surface. With practice this can be done so neatly as to quite conceal the mending. Pass an iron over the whole. When indiarubber cement cannot be obtained, glue mixed with one-fourth glycerine can be used.

Ammonia combined with wool forms a solvent which is also a cement. I have not experimented with it.

INVISIBLE MENDING OF GARMENTS, LACES, OR EMBROIDERIES

Most people are aware that there are tailors or others who are such artists in mending that they can sew up a rent "in almost anything" so skilfully that the tear cannot be perceived. I have myself seen this done so admirably in fine black cloth that not only was there no sign of a tear perceptible, but none was manifest after long wearing the garment. This nicety is partly due to skill, but there is also a method in it. Such mending is specially shown in Italy by Jewesses in repairing valuable old laces, embroideries, and the like. As a very large proportion of those who buy and sell such goods are Jews, it is but natural that their wives and female friends should be specially employed in mending. The process which they employ is as follows :—

"Thread a needle with one of your own hairs, then draw the edge of the rent or tear together in this manner, darning it, as it were, very finely and carefully, for it is in this that the whole art consists.

"After this take a piece of cloth as near like to the stuff you wish to mend as you can obtain. Lay this piece on the rent so as to cover it, then damp it slightly, and press it down with a hot iron until the surface looks quite even."

It may here be observed that, firstly, the *thinner* the thread used, so that it be only strong enough to hold, the less probability is there that the repair will show. For this purpose, for extremely delicate mending a human hair is almost invisible ; for most work silk thread will answer. It is, however, more likely to cut through the edge than a hair, because the hair is more elastic.

Secondly, it may be observed that the so-called darning is really a kind of invisible weaving, and not a sewing together or a stitching close of edges, which latter, as it always puckers up or rises, must show the line of repair. The darning has its strength of attachment afar off, not close to the edges ; it makes, as it were, a kind of network or a weaving together of the cloth—that is, the cloth is woven again into one piece by an invisible thread which hides itself in the thicker fabric. The laying down of a cloth of *precisely the same texture* as that mended, and then ironing it, is very ingenious, because one of a different kind would produce a different impression.

The friend from whom I received the above, Miss Roma Lister, adds that the Jewesses do this kind of work very well, but ask a franc or twenty-five sous for mending the smallest rent. However, when the torn shawl is once finished you cannot see where the hole has been.

Somewhat allied to this is the patient German method of mending stockings by reknitting ; also that of spreading strong flexible glue on a patch of chamois. This is laid under the rent, the edges being carefully reunited over it. I would here suggest that if the tear be first carefully darned, even with human

hair or finest silk, and the gummed leather then applied to the reverse, the mending would endure for a much longer time.

There is a stitch known in Germany as *Kettenstich*, or chain-stitch—though it is *not* that which is generally known among us as the "German chain-stitch." It is peculiarly long and strong, and will hold together the edges of even soft leather, for which reason it is generally used in Turkey and Russia to sew together the many-coloured pieces of leather such as we see in Kasan work—slippers and boots—and cushions from Constantinople. This is a valuable stitch for close, invisible mending. It is allied to the lock-stitch of the sewing-machine.

A great variety of fabrics can be carefully adjusted and drawn together over a piece of strong, glazed muslin (of the same colour) covered with waterproof glue—*e.g.*, indiarubber or glue and rubber cement—so that the mending will not be apparent. This process is very applicable to loose skirts, or to any garments on which there is no such severe pull, as, *e.g.*, trousers or coat-sleeves. To effect these as well as all other repairs perfectly it will be necessary to experiment a few times. Unfortunately nearly all amateurs without exception make no experiment till it is necessary to repair something, and then, because they very naturally botch it, find fault with the recipe. Yet, strangely as it may sound, there are many cases in which mending or making fabrics can be executed far more neatly with a very strong cement, such as that of mastic and sturgeon's bladder, than with needle and thread, the former actually requiring less margin to hold than the average width of a seam, for

the least possible overlap suffices to bind where the adhesive is strong. This process of mending is little known, probably because there has been hitherto very little general knowledge of the immense strength and tenacity of certain cements, which have, indeed, only been discovered of late. For all ordinary mending, in fact, glue with glycerine, or glue and indiarubber solution in benzole, will answer as well as the far more expensive Turkish or Diamond cement.

If the reader will only reflect that a large proportion of all black and glossy silks are heavily gummed, sometimes up to their own weight, it will be understood that there can be no substance with which they can be more appropriately mended than with cement —a fact well known to many who employ postage-stamps or black court-plaster to heal their rents ; but as this is generally very expensive, and as any old silk and glue or gelatine, or dextrine, answer just as well, the latter had better be considered.

There is much weaving of the most exquisite fabrics done in the East, and even among savages, almost entirely by hand ; that is to say, the threads are simply attached to a rod, while the woof is worked in with a needle. Most fabrics can be mended by an analogous process, which is a remaking the cloth. Much depends on the proper finishing or dressing the surface by laying on it a piece of cloth and ironing it.

MENDING MOTHER-OF-PEARL AND CORAL

Mother-of-Pearl is the shell of the pearl-oyster (*Avigula margaritifera*), much admired for its beautiful texture and white colour, in which there is a peculiar iridescence or rainbow play of colours. The best, and by far the principal portion in commerce, comes from the islands of the Pacific. It has risen immensely in value of late years. Almost, if not quite, equal to it is the East Indian, from the Sulu Islands, Ceylon, and Aden, or the Persian Gulf. An inferior kind comes from the Eastern Mediterranean, also another from America.

The iridescent glaze, accompanied with more or less of the mother or solid substance, is found in a very great number of shells ; *e.g.*, the Peter's Ear (*Halyotis iris*) of the Pacific ; also in common mussels, especially the *Unio*, found in most clear streams or brooks in Europe and America where there is not much lime. These often yield pearls of great value.

Mother-of-pearl can be sawed without any great difficulty into plates, which are polished with fine sand and then with tripoli. Of late a great deal of small furniture inlaid with squares and triangles of this material has found its way from Turkey and

Persia to London. These pieces are simply attached with cement made of sturgeon's bladder, mastic, salmiac, or even glue. They can generally be obtained from dealers in Oriental goods. ABRAHAM SASSOON, of Wardour Street, will supply them in any quantity.

LOUIS EDGAR ANDÉS and SIGMUND LEHNER, both experimental technologists, have given several curious recipes for imitating mother-of-pearl. From filing or grinding, the best mother-of-pearl shell becomes like a white metal, which can be combined with white of egg or pure white gelatine to a fine marble-like substance, which, however, lacks iridescence. Broken into very small pieces, which are set in a bed of glue and glycerine, and then covered, when dry, with another coating of the same, we have what its inventor, LEHNER, assures us is a very good imitation of pearl-shell.

But there is scaled away from a variety of shells a coating of *nacre*, or coloured glaze, which when powdered still retains the pearly lustre. This may be taken even from the common American oyster or all mussels. According to ANDÉS, who refers, I think, to this, it can be laid on any substance and covered with a gum-glaze. He also informs us that the pearl-like inner layers of oyster-shells, or of any other kind, reduced to powder and mixed with sturgeon's bladder and spirits, painted on grey paper in several coats, present the appearance of *nacre*. I have seen specimens of such painting which were indeed very pretty, but the pearly iridescence was rather faint. According to the author, the pearly brilliancy is much increased by an addition of silver-bronze powder.

I conclude from this, not having in this instance

experimented personally, save in carving pearl, that coarse powders of the highly coloured greenish and other *nacres* of tropical shells, as well as of the European mussel and some other shells, can be combined with binding-gums of a transparent nature so as to form a very admirable imitation of mother-of-pearl.

I may here remark, in connection with this, that the common American clam (*Venus mercernaria*) has a white shell of intense hardness, which, when polished, is as beautiful as porcelain or ivory ; also that the purple spot in the American oyster-shell, from which the Indians made a very hard and beautiful bead, might easily be drilled out for buttons.

A very beautiful imitation of mother-of-pearl is made in Japan. It is not, however, iridescent. It is said to be made with rice. I conjecture that this is rice treated with diluted acid.

I have before me now a string of 400 imitation red *coral* beads, price twopence, such as are commonly sold everywhere. They are manufactured of vermilion powder, rice-flour, and gum, and, when they are carefully made, are extremely hard and durable, so much so that the composition may be used to mend broken articles made of red coral. Such objects in a fractured state are very common in curiosity shops, but the art of repairing them seems to be as yet unknown, though it is extremely profitable.

Of coral, LEHNER tells us that celluloid in combination with different substances—*e.g.*, white zinc or cinnabar—can be coloured from delicate rose to fiery vermilion, and forms a very close imitation of coral. A very good and much cheaper imitation can be made by preparing perfectly white paper-paste (*vide* Papier-

Mâché), and combining it with vermilion, zinc, &c. From such artificial coral very beautiful cups, plates, and ornaments for inlaying, beads, pendants for jewellery, book-covers, &c., can easily be made. The colour can be varied to turquoise, emerald, ebony, ivory, &c., by simply changing the colouring-powders used.

There is a very cheap and common imitation of coral made by dipping vermicelli, twigs, &c., into a solution of red sealing-wax in spirits of wine. This is, however, extremely brittle. White marble-dust, or very fine white flint sand, combined with vermilion and silicate of soda, is said to produce a very admirable imitation of coral. The basis of levigated sand, or carbonate of lime, with silicate, can be varied with the dyes to imitate any gems, and is invaluable for mending pottery or stone-work.

Coral and several other substances are also imitated by combining about nine parts of very clear glue to one of glycerine. This is qualified with one equivalent of white zinc or dye-stuffs. Thus the glue basis is combined with colcothar, ochre-sepia, umber, ochre, or chrome. This is also a valuable cement for mending a great variety of objects.

Any fine white shells ground to powder may be combined with gum and a very little glycerine and vermilion to make artificial coral ; also white glue or gelatine with glycerine. This may be made in quantity for casts of all kinds of objects, such as plates in inlaid work.

RESTORING AND REPAIRING PICTURES

> "*The restoration of disfigured and decayed works of art is next in importance to their production.*"
> —Field, Chromatography.

I PUBLISHED in 1864 a work entitled *The Egyptian Sketch Book*, which began with the following abridged account of how oil pictures are cleaned :—

"Three young painters had often heard what the American PAGE has proved, that by carefully peeling the pictures of certain great artists, coat by coat, one may learn all their secrets of colour. So, having obtained an undoubted Titian, representing the Holy Virgin, they laid it on a table and proceeded to remove the outer varnish by means of friction with the fingers ; which varnish very soon rose up in a cloud of white dust, and acted very much as a shower of snuff would have done.

"Then they arrived at the 'naked colours,' which had by this time assumed a very crude form, owing to the fact that a certain amount of liquorish tincture, as of Turkey rhubarb, or *tinct. rhabarbara*, had become incorporated with the varnish, and to which the colours had been indebted for their golden warmth.

"This brought them to the *glazing proper*, which had been deprived of the evidence of the age or antiquity by the removal of the *patinæ*, or little cups, which had formed in the canvas between the web and the woof.

"The next process was to remove the *glaze* from the saffron robe, composed of yellow lake and burnt sienna. This brought them to a flame colour, in which the *modelling* had been made. They next attacked the robe of the Virgin Mary, and having taken away the crimson lake, were astonished to find a greenish drab. When they had thus in turn removed every colour in the picture, dissecting every part by diligent care, loosening every glaze by solvents too numerous to mention—including alcohol and various adaptations of alkali—they had the ineffable satisfaction of seeing the *design* in a condition of crude, blank chiaroscuro. Blinded by enthusiasm, having made careful notes of all they had done, they flew at the white and black with pumice-stone and potash; when, lo and behold! something very rubicund appeared, which further excavation declared was the tip of the red—nose of King George the Fourth! The Titian for which they had sacrificed so much was a false god."

The foregoing extracts were dictated by the late Henry Merritt, a very distinguished restorer and artist, the author of *Pictures and Art separated in the Works of the Old Masters*, and other works of which I can truly say that the name Merritt indicates that *nomen est omen*. I was often by him while at his work, and had the benefit of seeing the processes employed and the progress which he made in bringing to light

the "buried beauties" of pictures by great artists. What I have since learned in addition will be found in the following pages.

Though it is simple and easy to describe the manner in which old pictures in general are restored, it must be borne in mind that, as regards a detailed and comprehensive description, the task would be the most difficult in the whole range of repairing; for when a picture has suffered so much that repainting is absolutely necessary, then nothing but the skill of the original artist himself would ever do full justice to it. In many cases we have pictures, like decayed works in wood, so far gone that only a mere hint or sketch of the original remains, so that they are generally deemed not worth keeping. In such cases the restorer or repairer may very well do his best. There is, and always will be, an immense field for every skilled repairer in this remaking of antiques, to great profit, because there is an unlimited supply of material, almost everywhere, wherewith to work.

To be a perfectly accomplished restorer of pictures one should be an expert in chemistry, and not only one very familiar with all the styles and schools of art, and gifted with great knowledge of the *technique* of great artists, but also no mean painter oneself. There is a very general, but very vulgar and stupid, popular belief that the restoration and cleaning of old pictures is a merely mechanical art, about on a par with house-painting as regards skill or intelligence; but this I earnestly deny, having found, since I have practised it myself, that it affords a wide field to ingenuity, and that the greatest artists living—I care not who they may be—can find in restoration tasks

which would fully tax all their skill, knowledge, or genius.

Before proceeding to clean or repair a picture it is often advisable for the artist to make an outline sketch of it with great care, in order to correct and guide him in details. To do this, take very transparent tracing-paper—the recipe for making which is elsewhere given—then with a soft crayon-pencil, or a very black lead-pencil (from 3 to 4 B), trace the whole. If the paper be not transparent enough, then use thin glass, or, what is far better, sheets of mica, gummed together at the edges, which will not break even if dropped. Trace the picture on this with a fine brush and black oil-colour, or any black paint which will hold. Then make a tracing from this on transparent paper. To transfer crayon or lead pencil drawing to wood or paper, very slightly dampen the surface of the latter, lay the tracing on it face down, and rub the back of the latter with a burnisher or ivory paper-knife. It will thus be perfectly transferred. This making preparatory sketches or copies will be found in many cases extremely useful, as training the eye carefully to the work to be done.

It is not *invariably* true, though a great authority on picture-cleaning (Henry Mogford) has declared the contrary—that "pictures . . . unquestionably enjoy their highest perfection at the first moment of production." Many artists recognise the truth that a year, or even years, are needed to give a certain delicate tone, which is like the ripeness of fruit, to certain pictures; and the same is true of certain artists, though by no means in the same degree of all. But there are many persons who can associate the

mellowing tones of age or the venerable grey of antiquity with nothing but dirt, decay, and poverty ; as was the case with an Italian marquis, who, having heard that a distinguished artist[1] had copied an old moss-grown wall or fragment of ruin on his estate, sent an apology to the latter, stating that if he had known that such a distinguished person intended to copy it he would have had it cleaned and lime-washed, not in glaring white (he knew better than that, he said), but in light blue ! So I have known an American gentleman to be distressed at discovering the appearance of lichen on a corner of a " spick-and-span, brand-new villa," which he at once declared must be cleaned and painted all over. People who suffer from this vulgar mania of over-scouring are apt to imagine that when they detect the least sign of age in a picture it suggests dirt and neglect, and hurry it off to the cleaner ; unless, indeed (as is too often the case), they—with insufficient knowledge, and with " notions generally derived from guess-work, and suggested by the usual arrangements for taking care of other household objects"—attempt to restore the work themselves, which has been the cause of the ruin of thousands of great works of art.

It may here be observed that modern pictures, owing to the hurried processes of manufacture and the use of cheap materials in machinery-made paints, change so rapidly that many lose half their value in fifty years' time. And, as if this were not enough, we have the sulphuric acids generated by coal-fires (especially that from anthracite coal in America,

[1] The late W. W. Story, the sculptor and man of letters.

which even eats away the lime in chimneys), as well as the deleterious effects of gas, vapours from food, and, finally, the want of air and light in ever-curtained and shaded rooms.

The causes, in fact, which lead to deterioration in pictures are almost as many as those which produce diseases in man, and in not a few instances they will be found to be the same. These are, as I have said, foul air or malaria, or want of fresh air, dampness, the smoke of candles in churches, too long exposure to sunshine, the exhalations of charcoal, sulphur, sinks, &c.; "in short, all penetrating scents are injurious to painting, especially if it be new." Owing to this prevalence of gas and coal smoke in houses, allied to the bad quality of paints, as now manufactured cheaply by machinery, it is, indeed, considered doubtful whether any of the pictures painted during the reign of Queen Victoria will exist in "half-visible" condition fifty or a hundred years hence. There is, as regards them, a grand future for the restorer. One need only look at most of Turner's earlier pictures to fully verify what is here asserted.

The face of all old pictures long untouched will always be found covered more or less with what is simply dirt; that is, dust more or less dissolved by moisture. Now, dust consists simply of all kinds of substances, even invisible extinct animal organisms in vast numbers. The first step is simply to wash away this dirt with distilled or rain water and ox-gall. Use a very soft, clean sponge, and pass it over the picture many times. The last time wrap the sponge in a clean, white linen or muslin handkerchief to see whether the surface is quite clean. This and

nothing more will often produce an astonishing improvement.

The next task will be to remove the varnish. *Hot* water attacks any varnish, reducing it to a dry powder; but, as M. Goupil remarks, this is *très hasarde*, or is very risky, because it may also attack and dissolve anything like gum or glue in the colours. M. Goupil, however, sanctions the use of cold water in cleaning even to mere abuse, in which he is in contradiction to Henry Mogford, whose work I regard as by far the best with which I am acquainted on the subject of cleaning and restoring pictures which I have read.[1] On this subject he says :—

"During all operations of lining, and of picture-cleaning generally, saturation by water is attended with disastrous effects, and the use of it should therefore be limited to application by means of a squeezed piece of sponge, or, what is better, a piece of buff leather, soaked and wrung out. Water is a most dangerous enemy to pictures; it penetrates to the priming or ground, loosens them by promoting decomposition of the size with which they are worked, and thus lays the foundation for their eventual disintegration and decay. Imbibed damp will sooner or later cause the destruction of every woven material, and while our daily experience shows its lamentable effects on the walls of our dwellings, it will be well for us to remember that it is no less destructive to the canvas of our pictures, and to the materials which form its priming.

"All the pictures of the early masters of the Italian school, and those of Claude and William Vander-

[1] "Handbook on the Preservation of Pictures," by Henry Mogford; twelfth edition, revised. London: Winsor & Newton, 1s.

velde, which are painted on chalk and absorbent grounds, are in the greatest danger if washed with water. It penetrates through the small crevices which may exist in the paint, and often totally destroys the picture. If the painting be upon canvas, like those of the two latter-named masters, it breaks into a thousand small lines or cracks ; and if upon panel, like the pictures of Raffaelle, Andrea del Sarto, or Fra Bartolomeo, it breaks up the paint by scaling it off in small points of the size of a pin's head. If the picture, again, is of the Spanish school, and is painted upon the red absorbent grounds and upon a rough canvas, water not only breaks the unity of its surface, but from the canvas being of a coarser texture than the pictures of Claude or William Vandervelde, it often penetrates in a greater proportion, and frequently scales off pieces as large as a sixpence, especially in the dark shadows, or where the ground has not been sufficiently protected by a thick *impasto* (heavy coat or ground) of colour. At all times and to all pictures water is more or less dangerous, unless used with the greatest caution, and then it should only be applied by means of a piece of thick buckskin leather well wrung out, and left just wet enough to slip lightly over the surface of the picture. In the case of some masters, as with those we have specialised above, the free use of water may be regarded as next door to absolute destruction ; and the warmer and drier the weather the more active and ruinous the operation. Instances have occurred in which an Andrea del Sarto, a Claude and a William Vandervelde, were destroyed in a few minutes by the injudicious use of simple water."

I have given this quotation in full, because water is generally the first thing freely resorted to to clean pictures by the ignorant. Thus I have heard of very valuable pictures being actually given to common servants or the washerwoman to scour clean, which was

effected with soap and hot water and sand, to the speedy ruin of the work. Nor is it any great wonder that this should be done, when we find in GOUPIL's work that, while he admits that cold water "infiltrates itself partially to the fissures of a painting and does great harm," he declares that "*hot* water acts differently," giving the impression that it may be very freely used, and declaring that "clean cold water harmlessly dissolves grease and dirt resulting from dust deposited by the air." This is true, but he does not seem, like Mr. MOGFORD, to have fully understood the other side of the question. (*Manuel Général et Complet de la Peinture à l'Huile*, par F. GOUPIL.)

For first cleaning away impurities from a surface MOGFORD recommends *ox-gall* to be applied with a soft brush. This may be obtained in shilling or sixpenny bottles from Winsor & Newton, or any other dealers in artists' materials. "It is," he adds, "an excellent detergent, which may be freely applied without fear. It must, however, be well washed" (*i.e.*, wiped) "off with pure water, or it will leave a clamminess on the surface that may prevent the varnish, afterwards applied, from drying." But a distinction must be carefully borne in mind between *washing* with water and letting it *soak* into a picture and simply wiping off the surface with a damp chamois or buckskin or soft *old* linen handkerchief. In fact, this latter is the first thing to be done before slightly cleaning the surface with the diluted ox-gall. It is very necessary that the skilled cleaner shall understand exactly the nature of varnishes, so as to know on what he is to work. Thus, according to

the picture, he may employ "liquor potassæ, oil of tartar, spirits of wine, pure alcohol, liquor ammoniæ fortis, naphtha, ether, soda, and oil of spike or lavender. The very nomenclature of these powerful agents will at once show the great risk of their being injudiciously or carelessly employed."

Great care should be taken not to allow an excessive or unequal quantity of cleaning fluid to gather in one place. Therefore all pictures should be laid flat while being restored, as streams, for instance of ammonia, would cut very irregularly into a surface. With pictures of any value, the process of cleaning is always very delicate, requiring much practice and very perfect knowledge of all the principles of the art.

Where the varnishes are tender and thin, such as mastic, MOGFORD advises the use of spirits of wine; but to be sure that no harm can be done by it, it is desirable that "the spirit, which is usually sold at 58° of strength, should be diluted by a fourth part of water, or by the same proportion of rectified spirits of turpentine, or it may be used with an addition of a sixth part of linseed oil, added to the diluted or pure spirit." In every instance the mixture is to be "well shaken before taken," or applied. Care should be taken to prevent oil from softening the paint, which it is apt to do. As a rule it is best to begin with the lightest or brightest portions of a picture—as, for instance, the face of a portrait—as these parts are always the hardest. Beginning by wiping the surface with white cotton wool and turpentine, observe if any varnish comes off on it, and as soon as it is seen change the part of the rubber used, else you will go on simply taking up "dirt" from one place

and rubbing it into another. This is elsewhere explained as regards cleaning cloth or absorbing ink, that we must continually subtract from and not add again to the ground.

"Turpentine is a counteracting medium, which instantly arrests the action of the solvent spirit." When all the varnish has thus been removed, the whole may be wiped over with spirits of turpentine, and then when dry revarnished, if nothing more be required.

Rubbing with the fingers, or powders, or any kind of dry cleaning must be avoided, or else practised with great care, since it produces an effect known as *woolliness*, which will begin to show very decidedly after some time. But when a picture has had no varnish it can only be cleaned mechanically, as by using tripoli, pumice-stone, or whiting. This method requires great skill. Sometimes a very fine-edged scraper or knife is used to thin the varnish before using turpentine.

"Solvents," adds MOGFORD, "are only necessary to remove *varnish*." Unvarnished pictures are best cleaned by carefully wiping with buff or chamois leather, damp, not *wet*, aided by a little powdered whiting.

Varnish, when not on a picture, may, however, be removed by rubbing it with the fingers, or palm, or leather, aided by powdered resin, or rosin. For certain purposes, as to make a panel of a piano thoroughly seasoned for heat, and, as it were, enamel it, a coat of varnish is applied, and when dry is rubbed down smooth with pumice-powder or resin, and this process is repeated many times.

If pictures are painted in oil, directly on canvas, without a ground, the paint sinks down in between the threads and lies thinly on them. Therefore if there is rubbing on the surface the grain of the canvas becomes very apparent. If oil-paint be laid directly on a panel of wood, the soft parts between the hard fibres, lines, or grain shrink away, drawing the paint with them. Old artists avoided this by laying on a strong ground of gesso or plaster of Paris mixed with glue or white of eggs.

The great task in cleaning is to remove the repainting or coats of paint which have been added by restorers. I have seen this done with extraordinary skill by the late Mr. MERRITT, who was recommended by RUSKIN, and who was the first and most truly artistic restorer of his time. I can recall his cleaning the most beautiful Carpoccio which I ever saw, and a magnificent Velasquez, both of which had been repainted again and again, and were in such wretched condition that even the painter of the latter had been mistaken. They bore about the same relation when untouched and afterwards that a dirty old rag has to a magnificent cashmere shawl. "Caustic, soap-makers' lye, liquor potassæ, pure alcohol, and the scraper," remarks MOGFORD, "are the ordinary means to take off repaints; all of them dangerous appliances if not closely watched and used without violence or carelessness."

It is advisable to examine carefully the backs of old pictures for signatures, date, or documents, all of which are sometimes pasted over with other paper or canvas. Once, in Florence, I found in a small shop a portrait of Charles I., but differing in many respects

from any which I had ever seen. I told the owner that it was by Vandyke, but he insisted on it that it was by an Italian with some such name as Guillermo or Gillonio, till I proposed that we should examine the back, where we found, after some investigation, the name of Vandyke. At which discovery the dealer promptly raised the price of the picture from one hundred to one thousand francs, and it was, indeed, cheap enough at that. A lady to whom I narrated the occurrence said, "Oh, why didn't you buy the picture before you told the man who painted it?" To which I replied, "For the same reason that I did not steal a valuable ring out of the case in the shop when his back was turned." Much is said about the shrewdness of dealers in antiques, but it has often happened to me to explain to them that articles in their possession were worth far more than they imagined; while, on the other hand, they will, surmising that a thing *may* be worth a great deal, charge a fearful sum for something that is merely *cinque cento; e.g.*, a thousand francs for what is really dear at ten. I mention this in order that the reader may realise (which few do) what bargains may be picked up by any one who knows anything of art, and especially of the humble art of cleaning, mending, or restoring, which lets us into a world of secrets even in high art, and which is of more use to a picture-buyer than all the high-flown æsthetic culture in all the works of all the rhapsodists of the age.

The preceding remarks on *cleaning* were drawn chiefly from the manual by H. Mogford, and my own experiences. I add to them those of M. Goupil on the same subject. The intelligent reader will find

no difficulty in collecting and drawing his own inferences from both :—

"When the picture is certainly in oil, steam may be used to remove the varnish. There is, however, the great risk of loosening the painting from its ground."

But when a picture has been, instead of varnished, *glazed* with white of egg, we have a coating which, when old, cannot be dissolved by water or acids ; for this other and specially elaborate detergents, or cleaners, are employed. There are few substances which so persistently harden with time as the white of egg, as does also the yolk when boiled.

Ordinary varnish, when dry and old, can be removed by mechanically scraping or rubbing with fine, dry powders, such as that of resin. The dust from the varnish itself aids in the operation. This process is slow and tiresome, but it is very often advisable to begin with it, after washing, as it does not injure the colours. It is needless to say that it requires great skill, care, and experience not to "cut into the colour."

It may be remarked, as regards this, that in all cases where there is a difference of opinion between the French and English artist—as in the use of water —we must remember that both are, or may be, in the right as regards certain kinds of pictures. So varied are the methods of painters that it seems to me to be by far wiser to describe different methods than to attempt the impossible task of giving infallible rules.

"Varnish can be removed by means of *spirits*. To effect this, lay the picture on a table, and wet a small

portion of it with spirits of wine. After a minute or more, wash the place with clean water and a sponge. Thus, little by little, clean the entire surface, taking care not to injure the paint. When quite dry, apply new varnish."

Practised restorers, who can tell by examination and knowledge of the methods employed by painters what they can venture on, often use detergents which would ruin the picture if applied by a person without experience. These are alkaline salts, such as wood-ashes or lye, pearl and pot ashes, or salts of tartar, all of which, except the latter, are extremely hazardous for a tyro. Salts of tartar may be safely employed if we begin with a feeble solution, which may be gradually strengthened.

Wood-ashes, *very* finely sifted, are spread on the face of the picture, and delicately, or carefully and lightly, rubbed with a soft sponge. This must be carefully washed away as soon as the surface is cleaned.

Other detergents failing, borax dissolved in water may be employed. This works slowly but surely; but, as M. Goupil remarks, this *lessive*, like wood ashes, must not be left long on the colours, but be promptly wiped away with a sponge. Lime-water will serve as well as the solution of borax.

Soaps of different qualities are also used for cleaning, according to the state of the picture. It may be here again remarked that no exact rule can be given regarding an art specially founded on skill and experience. The beginner should first try his hand on a few common old pictures.

Soap made into a foam or lather with water will

generally clean a surface, however dark it may be from smoke. Let the foam settle completely, and then wipe it clean with a damp sponge.

Essential oils, especially turpentine, or those of spikenard, lavender, and rosemary—of either two parts of spirits of wine to one of turpentine, &c.—are commonly used to clean pictures.

Pictures not varnished require great care and skill in cleaning. For these *yeast* with water, or flour mixed with lime-water, is employed ; also spirits of wine or vinegar. Ammonia is also used. Goupil mentions that one of the most dangerous mediums for this purpose is the old one of urine, and that it should never be used.

When the canvas of a picture is very old and rotten, it may be replaced by a process requiring the utmost nicety. If only certain portions are injured, it will suffice to glue pieces of fine canvas on the back.

To completely transfer the painting, gum over its surface two coats of soft paper. Lay it on the face, and carefully remove the old canvas ground. This is effected by wetting every thread till soft, and then picking it away. A piece of pumice-stone and tweezers are also used. When all fibres are removed, carefully glue a canvas and apply it, pressing it well on the back of the paint. Before it is quite dry, press the picture with a warm flat-iron, not too hot. Then remove the paper carefully with a damp sponge and by tearing.

To transfer a picture on wood, the back is sawn into many small triangles or squares, which are carefully chiselled away one by one. Then with files and scrapers approach the paint till only a thin film of

wood remains. The last remnant is wetted with a sponge, and picked or scraped away. First, use paper on the face and restore as before.

There is a great enemy to pictures in mould or mildew, which has quasi-equivalents in must, dry-rot, *mucor*, or *robigo*. It is divided by GOUPIL into apparent softening and actual softening or mildew. The former is mildew or mere superficial mould ; *i.e.*, a light vegetation which gathers on the surface from germs in the air. It can easily be wiped away, and is caused by dampness. Sometimes, when long rooted, it destroys the varnish, which must be replaced. There is also a mould which is properly decay, or a radical destruction of fabric, for which there is, in fact, no cure, save in renewing the canvas and retouching the picture.

Where a picture is painted by glazing, especially where varnish comes in instead of body, it is apt to crack or thread like a cobweb. In time these divisions will scale off in flakes. Wax dissolved in turpentine is used for the light cracks. Scaling must be treated by careful softening with oil and pressing down a warm iron. The surface must, previous to ironing, be covered with chalked paper.

It sometimes happens that a picture has been painted over, and I have seen a very distinguished restorer in such case succeed in removing the outer coat. This requires great knowledge of the chemical properties of the paint ; also of solvents, and the different methods of scraping, absorbing, &c. Still, it can be learned with patience. Extraordinary results have been thus obtained. It has often happened that men with little or no knowledge of painting have fancied

themselves capable of "repairing" very valuable pictures, and so smeared them over to utter ruin.

Before attempting to retouch an old picture, let the restorer make a copy of it. If he can do this very well he is qualified for his work, and not otherwise. The fraternity of picture-cleaners and menders may protest against this; but the vast amount—I may say the vast proportion, meaning the majority—of good pictures spoiled by bad retouching confirms the truth of my assertion.

It is worth remarking in this connection that very few amateurs, æsthetes, or "connoisseurs," so called, appreciate the value of mere *technique* or practical work in art. They "swarm for the ideal," and that is all. The great masters were wiser than this. It would do much good if very generous prizes on a large scale were to be paid annually for copies of great pictures. And I would have rewards given specially for pictures painted with colours prepared by the artists themselves from chemically pure and unalterable materials, according to the ancient recipes. I would like to see a society formed of artists who would produce such work. It would certainly find buyers—in time.

There are to be found in most curiosity shops in Italy panel pictures of the fourteenth century, earlier or later, with gold grounds, which can be had of all prices, from a very few francs upward. They are without name and of no great artistic merit, but very curious and interesting indeed as ancient relics painted "before oil," and as inspired with the spirit of the Middle Ages. These generally require restoration. They were painted on wood of all kinds, very often

on deal. The surface was covered with a thin coat of gesso or plaster of Paris, mixed with the white of egg, and on this the gilding and paint were applied. The latter was in white of egg and fig-juice, or encaustic—that is, wax and white of egg, which is the most ancient and durable method known ; so much so that long after every oil-painting ever executed (if left to itself) will have disappeared, the ancient Egyptian, Roman, or Middle Ages pictures will be as fresh as if made yesterday.

If a panel be warped or bent, it is straightened by damping the concave side, and screwing to it cross-pieces. If the ground be scaled away, supply it with powdered plaster of Paris mixed with gum-water. The repainting can be executed with water-colours mixed with white of egg, *gouache*, or even oil in small quantities, which should be rather rubbed in or glazed than painted in body.

A common panel picture of the fourteenth and fifteenth century, painted with white of egg, can be well enough restored with water-colour, or *gouache*, and then varnished. But the colour with *gouache* medium will not *hold* well, except on the gesso-ground. It is apt to scale off from any smooth, hard surface. Therefore it is difficult to restore them by painting on the old hard glaze. Most of the mediums which are sold to heighten water-colours—*e.g.*, Winsor & Newton's glass medium—will cause the colour to adhere.

A GROUND FOR WAX-PAINTING ON POROUS SUBSTANCES was made as follows :—

White wax	10
Resin	5
Essence of turpentine . . .	40

Melt the wax in a *bain-marie*, pass the solution through a linen strainer, and lay it on in successive coats on a wall which is first heated by a hand-furnace or brazier. To close holes in the wall use a putty made of wax, gum-animé, resin, and whiting.

Colours are prepared for wax-painting by grinding them with a gluten. They are the same in substance as those mixed with oil for oil-painting. The gluten is made as follows :—

Resin	1
White wax	4
Essence of spikenard . . .	16

A harder gluten can be made by substituting copal for the gum-animé.

There is a vast field for profitable labour in the cleaning and restoration of old pictures, as well as of antiques of all kinds, and thousands of young or even elder artists, whose life is a painful struggle towards becoming known, would do well to endeavour to raise the art of restoration to its proper place, instead of being ashamed to descend to it.

The restorer should make a point of studying *varnishes*, *oils*, *and colours*, with great care. Let him read what cyclopædia articles and books he can find on these subjects, and make all practical inquiries from manufacturers and dealers. He should, if he intends to seriously practise the art, study chemistry. I can imagine no better restorer than a skilful analyst. There is a great deal yet to be learned regarding colours, and most of it will come by the way of chemistry. A great deal is, however, actually being revived or arriving as new from training "the popular eye" to hitherto unaccustomed shades, tints, and

tones. During the Middle Ages, when culture was exhausted in art and decoration, there was a marvellous development in this respect, even in most delicate details, though much of it now seems so "loud" or excessive to us. We have of late years learned a great deal from China and Japan as regards subdued colours. It may be that as in Oriental music even the tenth part of a note becomes as distinct to the practised ear as a natural one, so these blendings and subdivisions of hues may be as perceptible to people as the normal colours. All of this should be carefully studied by the restorer as well as the painter.

The restoration of a fine work of art which has become utterly dim, wrinkled with a thousand lines, and, it may be, utterly ugly to beauty and freshness, is so much like a resurrection or transfiguration to new life, youth, and beauty, that poets have not failed to use it as a simile for all that is expressive of renaissance. Thus Dean Hole, in his Memoirs, remarks that, "as when some beautiful picture which has been concealed and forgotten, removed in time of battle lest it should be destroyed by the enemy, is found after many years, and is carefully cleaned and skilfully restored, and the eye is delighted with the successive development of colour and of form, and the life-like countenance, the historical scene, the sunny landscape, or the moonlit sea come out once more upon the canvas ; so in that great revival of religion which began in England more than half a century ago the glorious truths of the Gospel were restored." Regarded in itself, the art of restoring beauty is both beautiful and noble, and deserves to be regarded as such.

GENERAL RECIPES

RECIPE.— *The word. A formula or prescription is a* recipe, *derived from the Latin word* recipe, *meaning take. An acknowledgment of money paid is a* receipt, *from* receptus, *or received. A description of the materials to be used in making a pie is not a* receipt, *but a* recipe."—Familiar Errors.

TO CLEAN WOOLLEN CLOTH.—Rub it with sal-ammoniac and water till clean, then wash with pure water. This liquid is very useful, when any article of clothing has been stained by vinegar, wine, or lemon, to restore the original colour.

An old-fashioned but excellent method of cleaning greased silk ribbons or cloth is as follows :—Lay the ribbon on a wad or flat surface of cotton wadding, strew on this dried clay, or calcined magnesia, or whiting, and over this another layer of wadding. Pass over it a flat-iron not too warm. The oil or grease will be absorbed into the cotton. Repeat this till the cure is effected. If any spots still remain, paint them with yolk of egg, dry the stuff in a draught of air, and when quite hardened remove the yoke and wash with water.

WINE-STAINS can be removed by simply *pressing* on them pads dampened with cold water. This method

will succeed, when wiping only spreads a stain. Salt alone is also employed.

"When a lady's skirt of any material has had spilt on it gravy, wine, oil, or any *light liquid*, as distinguished from such substances as paint, pitch, or tar, do not attempt, as is usually the case, to wipe or wash it clean. Lay a linen sheet or even spongy white paper—wanting this, newspapers may be used—on a table; on this spread the soiled fabric very evenly. Then lay on the upper surface another clean white sheet, or white muslin cloth, or napkins or towels, and press on it till as much as possible of the fluid is sucked out. By changing the white cloths or paper, and pressing continually, the fabric can be very nearly cleaned. Then dust it well with calcined magnesia in powder or whiting. Where these cannot be had chalk will answer. This will generally absorb all that remains of the grease."—*Notes by a Housekeeper* (*MS.*).

"Clean, dry blotting-paper laid on grease-stains is admirable for extraction. Apply pressure with a flat-iron or hand-roller such as is used for bread. There are blotting-paper rollers, made for ink, which are quite suitable for cleaning cloth; but the paper should be thrown away the instant it has received any grease; otherwise it will only spread the stain and make it indelible by rubbing it into the fibre of the threads. A good soft sponge will also be found to be almost equal to it."—*Notes by a Housekeeper* (*MS.*).

Old woollen or silk garments can be very brilliantly renewed in the following manner:—They are steeped in sulphuric cupreous acid (copper or blue vitriol), oxide of lead, or bismuth oxide, or simply

with their metallic oxides, and then exposed to steam, mingled with sulphuric acid gas. Another method is to steep the stuffs simply in a solution of sulphuric acid and copper or of oxide of bismuth. This is slowly heated, but the heating must be qualified according to the colour of the stuffs to be revived. The application of these requires great care and some knowledge or experience.

INK for restoring inscriptions on metal of any kind, silver, zinc, or brass :—To one part of crystallised acetic acid, oxide of copper, one of ammonia, and half a part of soot from fir wood. Mix in a saucer with ten parts of water. This is said to resist exposure to the weather very well.

A VERY VALUABLE AID TO THE RESTORER OR MENDER OF IMPLEMENTS, when it can be obtained, is RAW HIDE. This material dries as hard as any wood and is tougher than any textile fabric. Thus, if a broken wheel or any portion of a vehicle is tied with a thong of raw hide, firmly drawn, when the latter dries, shrinking a little, it holds better than iron. Raw or untanned ox-hide or similar skin, when dried, is in fact similar to parchment, and, like it, resembles horn in hardness. The strongest trunks in the world are made in America from raw hide. This material, when made into small objects, such as flasks, boxes, sheaths, or portable ink-stands, has often withstood the wear of generations. As it is cheap, easily moulded into form, or stamped, it is remarkable that it is no longer used as it once was.

LEAD-PENCIL OR CRAYON DRAWINGS can be preserved from rubbing by a light wash of gum of any kind, diluted varnish, or even milk. The latter is in most

cases preferable. It is also preservative of handwriting, and, like all glazes, prevents fading.

Bases for beads and similar work can be made as follows :—Take mother-of-pearl dust, which can be bought cheaply at a turner's, powder or levigate it finely, mix it with half its bulk of fine white barley-meal, and make it up with a weak solution of gum-mastic. Also take snail-shells, or the glaze of any large, hard sea-shells, washing them first in strong lye to clean them. Pulverise and make up with yolk of eggs and alum, or any other fine binder. The same can be done with rock-crystal or pure flint. Grind it to finest powder, and make it up with a well-incorporated mixture of the white of eggs and pure gum-arabic. This will, when dry, become hard as a stone, and more and more waterproof with age.

To pulverise Glass.—First put in the fire till red-hot, then drop it into cold water, after which reduce it in a mortar. Glass-powder thus made, mixed with almost any cement, renders it extremely hard. It is also mixed with paint.

Burnished steel or iron-work can be preserved from rusting by rubbing the article with oil of cloves or oil of lavender ; also with a mixture of turpentine, oil of lavender or cloves, and petroleum. Mercurial ointment is commonly used for guns.

Rust can be removed from iron by rubbing it with oil of tartar (*oleum tartari*), using a woollen rag.

Brass-ware, when it has become dull or rusty, may be renewed and made to look like gold. Take sal-ammoniac, grind it in a mortar with saliva ; rub this on the brass ; lay it on hot coals to dry it well, and rub it with a woollen cloth. So says Johann Wall-

BERGER ; adding : " With this art a certain man did once, in Rome, gain much money, inasmuch as he thereby did clean the brass lamps of the churches and other things of the same metal." There is another preparation for the same purpose still more gold-like. It consists of sulphur, chalk, and the soot from wood fires. But as it soon disappears, the brass should be lackered or varnished.

THE BEST CLEANER FOR BRASS with which I am acquainted is a German preparation used by BARKENTIN & KRALL, Regent Street, from whom it can also be obtained.

A VERY STRONG CEMENT, and one good for luting, can be made by combining sturgeon's bladder, dissolved in spirits, with finest pulverised flint or sand.

GLUE, into which resin has been well infused by heat, combined with sand or ashes or clay, forms a strong cement, useful for all kinds of coarse work.

A VERY GOOD, STRONG CEMENT is made as follows : —To three-eighths of a pound of water add three-eighths of a pound of spirits and a quarter of a pound of starch ; also, prepare two ounces of good glue in water, mixed with two ounces of thick turpentine, and stir well into the first composition. This is a very good bookbinders' glue.

THE TUFA OR SOFT STONE which abounds in Italy and elsewhere is much used when reduced to powder and burned for building. It is also useful as a cement. An old writer says it can be brayed in a mortar, but that " there are many who, for lack of a mortar, take old baptismal fonts out of the churches, and in lieu of a pestle use the clapper of a church bell."

A CURIOUS DECORATION may be made by drawing figures—for example, of animals—with glue or gum on a wall surface, and then powdering it with cloth-dust of appropriate colours. These figures can be stencilled.

As of all repairing and restoring that of *human beauty* is the most important, it may be worth while to give here a few recipes, which have held their own for centuries :—

TO MAKE WRINKLES AND FRECKLES DISAPPEAR.—This is more possible than is generally supposed, and I have known a lady, a great beauty, of whom all my readers have heard, who at fifty years of age had artificially and miraculously preserved her face in perfect smoothness, though I do not know by what means. The following is given by WALLBERGER :—"Take fine, pure alum, compound it carefully with the fresh white of eggs, and boil it gently in a pipkin, stirring it constantly with a wooden stick or spoon till it forms a soft paste. Spread this on the face, morning and evening, for two or three days, and you will soon see that it is free from wrinkles and freckles, and marvellously fair and pleasant to view. Frivolous souls may carry the sinful misuse of such beauty to their own account ; the virtuous hold in horror all such deeds" (*Zauberbuch*, 1760).

LEMON-JUICE or the salts of lemon, or lemon-juice and salt, are of great service in whitening the hands and causing freckles to disappear.

GUM-BENZOIN DISSOLVED IN SPIRITS may be had of every apothecary. Pour a few drops into a wine-glassful of warm water, and it will form a milk white emulsion, which is a perfect and harmless cosmetic

for the face, and serves as a delightful soap in washing. This is the *lac virginis* so much used two centuries ago.

Eau de Cologne mixed with water forms a white emulsion, which is much superior to any soap for delicate hands. It forms a perfectly harmless cosmetic for the face. Even a few drops of it in a basin of water will have a good result. Too much of it, or of any wash, will have a contrary effect, and dry the skin. If the mouth be rinsed with this emulsion of *eau de cologne* and water, it will purify the breath, and that for a long time if used as a gargle.

A strong marking-ink, or black dye, which will resist much exposure to the weather, is made as follows :—Take gum-arabic 10 lbs., logwood liquor (specific gravity 1.37) 20 fluid oz., bi-chromate of potash 2½ oz., with water sufficient to dissolve the bi-chromate. Dissolve the gum in one gallon of water, strain, add the logwood liquor, mix, and let the mixture stand for twenty-four hours ; then stir in rapidly the bi-chromate solution, and add a little nitrate of iron and fustic acid. If too thick, thin with lukewarm water.

A very hard cement can be made by digesting fluor spar for some time in sulphuric acid, adding magnesium sulphate and stirring calcined magnesia into the mixture.

A red cement for iron or stone or luting is made of red lead and litharge in equal parts mixed with concentrated glycerine to the consistency of soft putty. When dry it is water and fire proof.

Silico enamel is a thin liquid glaze, finer than varnish, which is easily applied to all polished metals, as

well as other substances. It may be obtained in bottles, price one shilling, with brush, of the Silico Enamel Company, 97 Hampstead Road, London, N.W.

LIGHT-COLOURED GLOVES may be cleaned by rolling bread-crumb over them ; also with indiarubber. Also by means of benzine. Several patent washes for this purpose are now sold.

CLEANING MARBLE.—"If 'Sculptor' will get some salts of wormwood, and dissolve in warm water, then mix with whiting into a moderate paste, and apply to stone or marble, and let it remain upon either for twenty-four hours—and if not successful the first time, apply again—he will draw all stains out of marble, and clear all lichen either from sandstones or oolitic stones. Thoroughly wash the stone with a strong soap (say, of Hudson's No. 2 soap powder) and lukewarm water, and, when thoroughly dry, give a coat of sulphurretted oil. He can make his own oil. Boil in a bath one quart of linseed-oil for one hour, with half-a-pound of flower of suphur, gently and continually stirring same ; then take off fire and let cool ; then pour oil from sediment, using oil upon stone. No lichen will hurt his stone if out exposed to the air, for the rain will wash all clean every time. I have cleaned several statues with nothing but Hudson's No. 2 and water."—*Work*, *April* 2, 1892.

CALCINED MAGNESIA, or calcined and powdered bone, laid for some time on simply oiled or greased marble, which has first been well washed with soap and water, will often extract the stain. For ink use oxalic acid in weak solution with water.

GUM-DEXTRINE, or gum substitute, is made from

roasted flour. It forms, mixed with water, a gum not much inferior to gum-arabic, for which it is, as the name denotes, a substitute. It is very extensively used in many manufactures, and may be obtained of any chemist. It sometimes happens that it is too brittle after drying, and does not hold. In such case add four or five drops of glycerine to a teacupful of the dextrine in solution.

Mouth Glue (Mundleim) or Solid Cement.—This is sold by stationers in thin, flat sticks or tablets, and is used by wetting and rubbing it, chiefly for paper. It is made as follows for labels :—

Sturgeon's bladder	25
Sugar	12
Water	36
Carbolic acid	

The sturgeon's bladder is first dissolved, the sugar then added, also a few drops of carbolic acid, which causes it to set more firmly, and also to resist mould in dampness, induced by the presence of sugar. This cement is applicable to glass, wood, or metal. Like the following, it has the advantage of being always ready to use, and requires no boiling. If it becomes too hard to use freely, let so much of it as is required steep for a time in water. Many think, from merely dampening it in the mouth when it is hard, and using it immediately, that it is a very weak adhesive, which is a mistake. A great deal of that sold by the stationers is, however, of very inferior quality, and made with very common glue.

Mouth glue in tablets :—

Transparent glue, No. 1 . . .	24
Sugar	13
Gum-arabic	5
Water	50

The glue, sugar, and gum are boiled in the water until a drop let fall on a slab hardens. It is then rolled and cut into flat cakes.

To mend or make Meerschaum Pipes.—Dissolve caseine in silicate of soda ; stir into the cement fine calcined magnesia. By the addition of meerschaum powder a close imitation of meerschaum in the mass can be made.

Turkish cement of the strongest kind, and such as is used to attach gems to metal, is made as follows :—

Sturgeon's bladder cement . .	30
Mastic (best)	2
Gum-ammoniac	1
Spirits of wine	10

The sturgeon's bladder, shredded, is dissolved with spirits of wine while remaining in a warm place ; the gum is also dissolved in spirit and mixed with the sturgeon's bladder ; the whole must be then carefully and slowly boiled to a syrup. Close with a cork, as it is sure to gum tightly.

To improve Corks.—When bottles contain substances which adhere to the *cork* and *harden*, the latter should be first steeped in oil or vaseline, or boiled in a mixture of both.

Armenian Cement.—This is much like Diamond and Turkish cements :—

I.

Sturgeon's bladder	600

II.

Gum-ammoniac	6
Mastic	60

The sturgeon's bladder is dissolved in spirits of wine separately, the gum-ammoniac and mastic also, but with a minimum of spirit ; the two are then combined.

A cement which will resist the action of spirits of wine will often be very valuable, as when large lids are to be fastened to jars containing anatomical preparations. One is made as follows :—

Cleaned manganese powder . .	20
Soluble silicate of soda . . .	10

This must be freely used to make the cover adhere. When in time it shall become brittle, coat it over with a thick solution of asphaltum in turpentine or petroleum.

To seal bottles very securely, roughen the opening or mouth with a file or glass-paper, drive in a hard cork till half-an-inch below the top, and then seal it with silicate of soda mixed with marble-dust.

Chloride of zinc added to silicate of soda and oxide of zinc forms a very good cement, which will resist most influences.

Bread macerated with glue or gelatine, with a little glycerine, makes an admirable substance for artificial flowers, casts, medallions, &c. If worked with gum-

arabic and a little alum, or dextrine, or common mucilage, we shall have the same result. It can also be worked with thin varnish or gutta-percha cement; also with diluted sulphuric or nitric acids to produce a hard substance. It may here be observed that *bread* is for certain work far superior to flour or starch paste, since the combination with *yeast* causes a development of cellular tissue, the result of which is a firmer and more wax-like substance. I was led to observe this at first, not from what I read of the action of acids on bread, but from observing the bread-flowers made by the Italian peasantry to adorn images of saints. I believe that in these there is a little vinegar mixed. They are quite wax-like. The bread used should be soft household bread, of course well kneaded with the acid and colours. Bread-paste would probably combine well with indiarubber in solution.

Of late, German illustrated newspapers have published patterns of small ornamental dishes made of dough or bread, intended to receive conserves of fruit and other edibles—the dishes themselves not being intended to be eaten.

Soft bread with a little varnish or any ordinary gum and a little glycerine, well worked, makes an admirable filler for cracks in wood. Combined with any gum, or even with tragacanth or peach or cherry gum, and lamp-black (or liquid Indian ink), it forms a cement which resembles ebony. The more thoroughly it is macerated the harder it will be. Casts of panels, &c., made with this are really beautiful. Rub with oil and the hand after it is quite dry. Add a few drops of glycerine and alum in solution to prevent cracking, or, better, a *little* indiarubber. Soft

rye bread hardens to a rather tougher cement than wheat. Bread cement makes an admirable ground for gilding or painting. Bread macerated with lime and white of egg forms a very hard composition like ivory. Bread, glue, and glycerine, *ditto*.

Horse-Chestnut Paste.—This is called a cement, but it is properly a paste like that of flour. Horse-chestnuts are generally neglected, but they can be profitably utilised for paste, which admits of the same combinations as flour.

Waste tea-leaves from which the tea has been extracted can be macerated with gum and treated as rose-leaves to form artificial ebony. Carefully separate all the hard portions.

Gum for general use, like gum-arabic :—

Common sugar, by weight . .	12
Water	36
Slacked lime	3

Stir the lime into the warm solution of sugar and water. Keep it boiling and stir it often for one hour. Pour off the liquid from the lees of the lime. This gum also admits of modifications. One of these is the well-known Syndetikon, which is made as follows :—To fifteen parts of the sugar and lime solution add three of good glue, leaving them to soak for twenty-four hours ; warm gradually, and frequently stir, till the glue is dissolved. Then let it boil for a few minutes. This makes a good plain cement, which serves to unite paper, leather, glass, or porcelain. It, however, spots or changes colour in paper, &c.

A GENERAL CEMENT, which may be used for joining metal and glass, stone, tiles, &c., is thus made :—

Plaster of Paris	21
Iron filings	3
Water	10
White of eggs	4

THE GENERAL MENDING CEMENT so commonly sold consists of nothing but—

Gum-arabic	1
Plaster of Paris	3

This must be mixed with water when used. It does not, however, resist the action of hot water.

A CEMENT WHICH RESISTS ACIDS is made as follows : —Indiarubber is dissolved in double its weight of linseed-oil, and kneaded to a dough with white bolus. Should the cement harden too quickly, add to it a little litharge.

INDIARUBBER CEMENT FOR CHEMICAL APPARATUS :—

Indiarubber	8
Tallow	2
Linseed-oil	16
White bolus	3

This does not resist high temperature, but is good against acids.

SCHEIBLER'S CEMENT FOR CHEMICAL APPARATUS :—

Gutta-percha	2
Wax	1
Shellac	3

SOREL'S CEMENT.—This consists of oxide of zinc

combined with its chloride. The chloride of zinc is in a heavy, syrupy form, which, combined with the white oxide, sets very hard. It is chiefly used for filling teeth, but is also applicable to making medallions and other objects of art. For this latter purpose it is mixed with powdered chalk, pulverised glass, &c. The process of preparing and combining the ingredients of this cement is, however, so tedious that it is most unlikely that the ordinary repairer will care to attempt it ; the more so as there are many preparations far superior to it.

GLUE FOR TAPESTRY, &C.:—

Flour-paste	100
Alum water	3
Dextrine-paste	5

This may also be applied in many ways.

TO LUTE STILLS, &C.:—

Glue in powder	20
Flour	10
Bran	5

To be well mixed with water.

As alum cannot be affected by petroleum, it is used to fasten rings to petroleum-lamp holders. These are lined with alum which has been melted by heat. Alum melted forms a strong cement for glass and metal.

PASTE FOR WALL-PAPER.—Ten parts of flour are made into common paste ; add one of glue boiled in hot water ; add to the whole one-twentieth part of white of egg. This holds very firmly. Paste made with flour and gum-arabic, &c., does not mould or

turn sour if it be mixed with a few drops of oil of cloves or carbolic acid.

Clay Mortar.—Where lime cannot be had, a very good mortar for chimneys may be made by mixing clay with common molasses. This is said (Lehner) to resist the action of heat when well dried.

Another fireproof cement is made as follows :—

Clay	40
Flint-sand	40
Slacked lime	4
Borax	2

This is mixed with a very little water. It is used as a wash, and should, when dry, be heated by fire.

Log cabins and houses built with wood are, in America, often swarming with vermin to a degree which would seem incredible. In all such cases the joints and cavities should be well packed, and plastered with cement—lime if possible—and then whitewashed. Rat-holes should be plugged with stones or gravel and then cemented.

Zeiodeleth.—Vessels of wood, iron, stoneware, or of moulded cement, are often eaten away by the action of acids and alkalies. To prevent this they are in Germany coated with a composition called *Zeiodeleth*. In its simplest form this is simply sulphur mixed with *very finely* sifted flint-sand, or else ground glass, chinaware, or stone. Of this thin plates are also made to coat such vessels, or even to form them.

Merrick's Zeiodeleth :—

Sulphur	20
Glass-powder	40

Böttger's Zeiodeleth (Lehner) :—

Powdered flint	90
Graphite	10
Sulphur	100

I.

A fluid paste is made by pouring into a porcelain jar 5 kilogrammes of potato-starch with 6 kilogrammes of water and 250 grammes of white nitric acid. Keep the whole in a warm place for forty-eight hours, stirring it frequently, and then boil it till syrupy and transparent. Add a little water, or sufficient to make it fluid enough to be filtered through a closely woven towel.

II.

Dissolve 5 kilogrammes of gum-arabic to 1 of sugar in 5 quarts of water, adding 50 grammes of nitric acid ; warm to boiling, and then add No. I. The result is a perfectly fluid adhesive, which will not mould, and dries on paper with a glaze. It is adapted for postage-stamps, marking over impressions, and fine stationery.

Durable Flour-Paste for Stationers.—Take good flour-paste, adding to it while boiling one-tenth part of clear liquid glue, to be well stirred in. Add a few drops of carbolic acid or oil of cloves. Keep it corked in wide-mouthed, large vials.

Dry Cement, or Travellers' Glue :—

Glue	600 grms.
Sugar	250 ,,

The glue must be of the best quality, and perfectly melted in water, as usual, and the sugar stirred in. It is then steamed away until it becomes hard when cold. To use, place it in hot water, when it at once liquefies. This is specially used for paper.

Coating to protect trees from insects :—

Colophonium (resin) . . .	100
Common soap	100
Tar	50
Whale-oil	25

Smear the trunks of the trees with this. It may also be put on sheets of brown paper to catch flies.

Cement for Filling.—Take fresh curd (caseine), and knead it with water to a putty. It can be used in this state for many purposes. To greatly harden it, add one-twentieth of its weight in lime, and more or less of some indifferent substance, such as chalk, calcined magnesia, oxide of zinc, and colouring matter. This sets so hard that it may be used to make casts or many small works of art.

French Glues.—Two very excellent glues used in France are the *colle forte de Flandre* and that of *Givet.* Goupil recommends as the best glue, where a very superior article is required, one made of equal parts of the two. Break them up, let the pieces remain fifteen hours in water, then boil for two hours in the *bain-marie*, or glue-kettle. After a time the glue will settle and become clear. Add, if needed, a little water from the *bain-marie.*

To give a Satin Gloss to Paper.—Paint with a broad, soft brush on the paper with a solution of

hypo-sulphite of barium (chemically expressed by BaS_2O_3). It may be laid on by itself or mingled with a colour. It is used sometimes by bookbinders. This may be applied in water-colour pictures to the imitation of silk or satin.

Gomme laque, or shellac, also gelatine glue, is sold in thin leaves. To prepare it, put into a *bain-marie* twenty parts of the gum to one of flowers of sulphur, stir it well, and add a little lukewarm water. It may be made into little bars by hand ; let them cool, and warm them when required for use.

A very good cement, which, according to Fred. Dillaye, is both fire and water proof, is made as follows :—Take half-a-pint of milk, as much vinegar, mix them, and take away the whey. Add the white of five eggs to the curd, mix the whole well, and add so much finely sifted quicklime as will form a paste.

Snail Cement.—It is said that snails or slugs, mashed, form a strong and hard glue. This is probable ; also, that it would combine with powdered quicklime, or carbonate of lime in powder, to set very hard.

To mend marble use shellac in leaves, mixed with white wax.

To mend alabaster use gum-arabic mixed with powdered alabaster. This is also useful for many other purposes.

A cement useful for many purposes, also as a ground for painting, is made as follows :—Take barley and soak it in six equivalents of water for several days, or till the barley expands or sprouts. Throw out the barley, after pressing it. This gives a glutinous liquid, which, combined with pipeclay and white

soap, sets hard. It is improved by adding the powder of calcined bone. Barley water may also be used in many other combinations. Gum-arabic and thin glue, dextrine, and fish-glue may be used in its place.

A STRONG CEMENT FOR HORN OR TORTOISE-SHELL :—

Glue (fluid)	1½
Sugar-candy	3
Gum-arabic	¾

The two latter to be dissolved in six parts of water.

ANOTHER FOR THE SAME :—Take strong lime-water ; combine it with new cheese. The latter is to be mixed with two parts of water, so as to form a soft mass. Pour into this the lime-water, but see that there is no solid cheese in it. This will form a liquid which can be used as a cement.

CAT-GUT, which is, however, made from the intestines of sheep, &c., is of great service in some kinds of repairing, owing to its strength. It can be made into very small cord, which will sustain a man.

Very strong cords for fishermen are also said to be made by taking silkworms just before they spin, cutting them open, and using the silk, which is then found in a solid, longish lump, and which can be artificially drawn out into any shape. It is probable that the silk in this state could be thinned and applied in combination with fibre to produce useful results. It is also probable that this substance, or the silk *en masse*, could be used for mending silk fabrics in many ways. It could be produced very cheaply, because the greatest expense in manufacturing silk is the reeling, winding, and spinning the thread.

An incredibly strong and serviceable silk is spun

by the *elm-worm*, which can be raised in any quantities wherever elm-trees abound. This is much cultivated in China, and it is said that garments made of its silk descend from father to son. It is several times larger than the silkworm, and survives even the severe winters of Canada. It would be much easier to raise than the delicate *bombyx*, or common silkworm. It is worth noting that a man can carry easily in his pocket fifty yards of cat-gut or elm worm silk cord strong enough to sustain his weight, which is very useful for travellers to know, since it is useful to mend harness or tether horses.

To soften Horn.—This material can be softened so as to bend in hot water. It requires long boiling. According to Geissler, a horn can be moulded to shape by steeping the horn for two or three days in half a kilogramme of black alicant, 375 grammes of newly calcined lime, and 2 litres (two full quarts) of hot water. Should the mixture assume a reddish colour it is all right ; if not, add more alicant and lime. After the horn has been moulded, dry it in well-dried common salt. Horn shavings and filings are made into a paste, which hardens by being in a strong solution of potash and slacked lime, in which it becomes jelly-like and can be moulded. This must be subjected to pressure to expel the moisture. By adding a little glycerine its brittleness is much diminished.

Artificial Bonework.—Reduce the bone or ivory to a very fine, flour-like powder, mix it very thoroughly with the white of eggs, and a very hard and tough mass will be the result. This can be turned and highly polished. This is improved in hardness

and quality by grinding the mass again and subjecting it to heat and pressure (*Die Verarbeitung Hornes, &c.*, von Louis Edgar Andés ; Vienna, 1892).

To properly dust Clothes.—The following extract on cleaning garments is taken from my forthcoming work, entitled *One Hundred Arts* :—

"The obvious way to remove dust from a coat—as some take evil out of children (*vide* Northcote's *Fables*)—is by whipping or beating with a stick. This, indeed, effects the purpose, but it speedily breaks the fibre of the cloth. Therefore in Germany, as in Italy, a little *bat* plaited of split cane or reeds is employed to exorcise the demon of dust, known as *Pāpākeewis* to the Chippeways. But better than this is a small *whisp-broom*. Half a century ago this simple contrivance was only known in the United States and in Poland.

"Whip the garment with the *side* of the soft whisp, and as the dust rises to the surface brush it away. If the reader will try this on any coat, however clean it may be, he will be astonished to find how much dust he will extract or raise.

"All the dust which thus lies hidden in cloth, when it comes to the surface, acts as *grit* or powder insensibly but certainly, and helps to wear away the surface whenever it is touched. That we take in dust every time we go out will appear from inspecting a silk hat. Again, the dust on a coat, &c., every time it is rubbed by the cleanest hand, takes in grease, which in time aids in spoiling the surface. In fact, half the wear-out of all cloth is due to dust alone.

"Therefore, if we *carefully* dust our clothes with a whisp, every time we take them off, fold them with care, and lay them in a drawer, they will last much longer than they do. Pure air free from dust is as conducive to the well-being of coats as to that of their wearers, and Dominie Sampson uttered more truth

than he imagined when he observed that the atmosphere of his patron's dwelling was singularly preservative of broadcloth."

In proof of this it may be observed, that as a sand-blast attacks some substances exclusively, so dust or grit injures certain fabrics and not others, and that the latter are all known as the more lasting fabrics.

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